

THE BRIDGEWATER TREATISES

ON THE

POWER, WISDOM, AND GOODNESS OF GOD, AS MANIFESTED
IN THE CREATION.

TREATISE I.

ON THE ADAPTATION OF EXTERNAL NATURE TO THE MORAL AND INTELLECTUAL
CONSTITUTION OF MAN.

BY THE REV. T. CHALMERS, D.D.



ON THE
POWER, WISDOM, AND GOODNESS

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MANIFESTED IN THE ADAPTATION OF EXTERNAL NATURE TO THE MORAL AND
INTELLECTUAL CONSTITUTION

OF

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BY THE

REV. THOMAS CHALMERS, D.D.

PROFESSOR OF DIVINITY IN THE UNIVERSITY OF EDINBURGH.

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TO THE

RIGHT HONOURABLE AND RIGHT REVEREND

CHARLES JAMES,

LORD BISHOP OF LONDON.

MY LORD,

YOUR Lordship's personal kindness to myself would alone have inclined me to solicit for this work the honour of your patronage and name.

But I must further confess the peculiar satisfaction which I feel, in offering it as a tribute and a public acknowledgment of my admiration for an order of men, who, more than all others, have enriched by their labours the moral and theological literature of England.

In the prosecution of that arduous and hitherto almost unattempted theme which the late President of the Royal Society has, by your Lordship's recommendation, assigned to me, I have derived greater aid from the views and reasonings of Bishop Butler, than I have been able to find besides, in the whole range of our existent authorship.

With his powerful aid I commenced the high investigation to which your Lordship has called me. To imagine that I have completed it, would be to forget at once the fulness of the Creation, and the finitude of the Creature. Whatever the department of Nature may be which we explore, in quest of evidence for the perfections of its Author, there is no inquirer, though even of the most transcendent powers, who shall ever attain the satisfaction of having traversed the whole length and breadth of the land. He will have but entered and proceeded a certain way, within the margin of a territory, whose riches are inexhaustible.

That your Lordship may long continue, by your zeal, and talents, and lofty erudition, to sustain the honours, and to promote the vital good of our Religious Establishments in this empire, is the fervent desire and prayer of

My Lord,

Your Lordship's most obliged
and obedient Servant,

THOMAS CHALMERS.

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Edin. May 13, 1833.

THE HISTORY OF THE UNITED STATES

The first part of the book is devoted to a general history of the United States from its discovery to the present time. It is divided into three periods: the colonial period, the revolutionary period, and the federal period.

The colonial period is the most interesting and important part of our history. It shows the growth of the colonies from a few scattered settlements to a powerful and independent nation.

The revolutionary period is the most glorious and heroic part of our history. It shows the struggle for independence and the birth of a new nation.

The federal period is the most important and interesting part of our history. It shows the growth of the Union and the development of the American people.

The book is written in a simple and plain style, and is intended for the use of schools and libraries.

The book is published by the American Book Company, New York.

NOTICE.

THE series of Treatises, of which the present is one, is published under the following circumstances :

THE RIGHT HONOURABLE and REVEREND FRANCIS HENRY, EARL of BRIDGEWATER, died in the month of February, 1829 ; and by his last Will and Testament, bearing date the 25th of February, 1825, he directed certain Trustees therein named to invest in the public funds the sum of Eight thousand pounds sterling ; this sum, with the accruing dividends thereon, to be held at the disposal of the President, for the time being, of the Royal Society of London, to be paid to the person or persons nominated by him. The Testator further directed, that the person or persons selected by the said President should be appointed to write, print, and publish one thousand copies of a work *On the Power, Wisdom, and Goodness of God, as manifested in the Creation ; illustrating such work by all reasonable arguments, as for instance the variety and formation of God's creatures in the animal, vegetable, and mineral kingdoms ; the effect of digestion, and thereby of conversion ; the construction of the hand of man, and an infinite variety of other arguments ; as also by discoveries ancient and modern, in arts, sciences, and the whole extent of literature.* He desired, moreover, that the profits arising from the sale of the works so published should be paid to the authors of the works.

The late President of the Royal Society, Davies Gilbert, Esq. requested the assistance of his Grace the Archbishop of Canterbury and of the Bishop of London, in determining upon the best mode of carrying into effect the intentions of the Testator. Acting with their advice, and with the concurrence of a nobleman immediately connected with the deceased, Mr. Davies Gilbert appointed the following eight gentlemen to write separate Treatises on the different branches of the subject as here stated :

THE REV. THOMAS CHALMERS, D. D.

PROFESSOR OF DIVINITY IN THE UNIVERSITY OF EDINBURGH.

ON THE ADAPTATION OF EXTERNAL NATURE TO THE MORAL AND INTELLECTUAL
CONSTITUTION OF MAN.

JOHN KIDD, M. D. F. R. S.

REGIUS PROFESSOR OF MEDICINE IN THE UNIVERSITY OF OXFORD.

ON THE ADAPTATION OF EXTERNAL NATURE TO THE PHYSICAL CONDITION OF MAN.

THE REV. WILLIAM WHEWELL, M. A. F. R. S.

FELLOW OF TRINITY COLLEGE, CAMBRIDGE.

ON ASTRONOMY AND GENERAL PHYSICS CONSIDERED WITH REFERENCE TO NATURAL
THEOLOGY.

SIR CHARLES BELL, K. H. F. R. S. L. & E.

THE HAND : ITS MECHANISM AND VITAL ENDOWMENTS AS EVINCING DESIGN.

PETER MARK ROGET, M. D.

FELLOW OF AND SECRETARY TO THE ROYAL SOCIETY.

ON ANIMAL AND VEGETABLE PHYSIOLOGY.

THE REV. WILLIAM BUCKLAND, D. D. F. R. S.

CANON OF CHRIST CHURCH, AND PROFESSOR OF GEOLOGY IN THE UNIVERSITY OF OXFORD.

ON GEOLOGY AND MINERALOGY.

THE REV. WILLIAM KIRBY, M. A. F. R. S.

ON THE HISTORY, HABITS, AND INSTINCTS OF ANIMALS.

WILLIAM PROUT, M. D. F. R. S.

ON CHEMISTRY, METEOROLOGY, AND THE FUNCTION OF DIGESTION.

HIS ROYAL HIGHNESS THE DUKE OF SUSSEX, President of the Royal Society, having desired that no unnecessary delay should take place in the publication of the above-mentioned treatises, they will appear at short intervals, as they are ready for publication.

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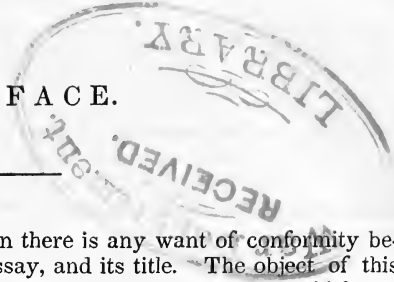
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P R E F A C E .



It is an incongruous thing, when there is any want of conformity between the subject matter of an essay, and its title. The object of this explanatory preface is to show that it is an incongruity into which we have not fallen.

In the first place we were not in fair circumstances for expounding the adaptation of external nature to the mental constitution of man, till we had made manifest in some degree what that constitution is. There is no distinct labourer in that conjunct demonstration of the divine attributes which is now being offered to the world, to whom this essentially preliminary topic had been assigned as the subject of a separate work. It was therefore unavoidable, that, to a certain extent we should undertake it ourselves, else, in proceeding to the construction of our argument, we might have incurred the charge of attempting to rear a superstructure, without a foundation to rest upon.

But in the execution of this introductory part of our subject, we could scarcely have refrained from noticing the indications of divine wisdom and goodness in our mental constitution itself, even though our strictly proper, because our assigned task, was to point out these indications in the adaptation of this constitution to external nature. We could not forget that the general purpose of the work was to exhibit with all possible fulness the argument for the character of the Deity, as grounded on the laws and appearances of nature. But we should have left out a very rich and important track of argument, had we forborne all observation on the evidence for the divine perfections, in the structure and processes of the mind itself, and confined ourselves to the evidence afforded by the relations which the mind bore to the external world. In the adaptation of external nature to man's physical constitution, there are many beautiful and decisive indications of a God. But prior to these, there is a multitude of distinct indications, both in the human anatomy, and the human physiology, viewed by themselves, and as separate objects of contemplation. And accordingly, in this joint undertaking, there have been specific labourers assigned to each of these departments. But we have not had the advantage of any previous expounder for the anatomy of the mind, or the physiology of the mind; and we felt that to have left unnoticed all the vivid and various inscriptions of a Divinity, which might be collected there, would have been to withhold from view some of the best attestations in the whole range and economy of nature, for the wisdom and benevolence of its great architect.

But to construct a natural theology on any subject, it is not necessary to make of that subject a full scientific exposition. The one is as distinct from the other, as the study of final is from the study of efficient causes—the former often lying patent to observation, while the latter may be

still involved in deepest obscurity. It were a manifest injury to our cause, it were to bedim the native lustre of its evidences—did we enter with it among the recondite places of the mental philosophy, and there enwrap it in the ambiguity of questions yet unresolved, in the mist of controversies yet unsettled. Often, though not always, the argument for a God in some phenomenon of nature depends upon its reality, and not upon its analysis, or the physical mode of its organization—on the undoubted truth that so it is, and not on the undetermined, perhaps indeterminate question of how it is. We should not have shrunk from the obscurer investigation, had it been at all necessary. But that is no reason why time must be consumed on matters which are at once obscure and irrelevant. It is all the more fortunate that we are not too long detained from an entry on our proper task, among the depths or the difficulties of any preliminary disquisition which comes before it—and that the main strength of the argument which our mental constitution, taken by itself, furnishes to the cause of theism, lies not in those subtleties which are apprehended only by few, but in certain broad and palpable generalities which are recognised by all men.

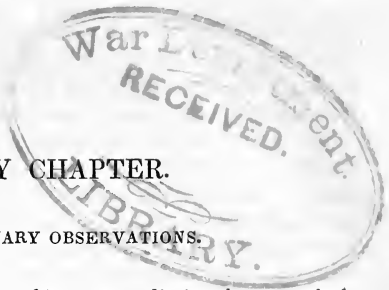
But there is another explanation which we deem it necessary to make, in order fully to reconcile the actual topics of our essay, with the designation which has been prefixed to it:

If by external nature be meant all that is external to mind, then the proper subject of our argument is the adaptation of the material to the mental world. But if by external nature be meant all that is external to one individual mind, then would the subject be very greatly extended; for beside the reciprocal influence between that individual mind, and all sensible and material things, we should consider the reciprocal influence between it and all other minds. By this contraction of the idea from the mental world to but one individual member of it; and this proportional extension in the idea of external nature from the material creation to the whole of that living, as well as inanimate creation, by which any single man is surrounded; we are introduced not merely to the action and reaction which obtain between mind and matter; but, which is far more prolific of evidence for a Deity, to the action and reaction which obtain between mind and mind. We thus find access to a much larger territory, which should otherwise be left unexplored—and have the opportunity of tracing the marks of a divine intelligence in the mechanism of human society, and in the framework of the social and economical systems to which men are conducted, when they adhere to that light, and follow the impulse of those affections which God has bestowed on them.

But in the progress of our argument, we come at length to be engaged with the adaptations of external nature, even in the most strict and limited sense of the term. In the origin and rights of property, as well as in the various economic interests of society, we behold the purest exemplification of that adjustment which obtains between the material system of things and man's moral nature—and when we proceed to treat of his intellectual constitution, it will be found that the harmonies between the material and the mental worlds are still more numerous, and more palpably indicative of that wisdom which originated both, and conformed them with exquisite and profound skill to each other.

INTRODUCTORY CHAPTER.

GENERAL AND PRELIMINARY OBSERVATIONS.



1. EXTERNAL nature, when spoken of in contradistinction to mind, suggests chiefly, if not solely, the idea of the material universe. Even though restricted to this limited and proper sense of the term, we should still behold the proofs of beneficent design in the fitnesses of the one to the other; but far more abundantly and decisively, it must be confessed, in the adaptation of external nature to the physical, than in its adaptation to the moral and intellectual constitution of man. For fully developing our peculiar argument, an enlargement of the meaning commonly affixed to external nature seems indispensable,—an enlargement that we should not have ventured on, if in so doing we crossed the legitimate boundaries of our assigned subject; and that, for the mere purpose of multiplying our topics, or possessing ourselves of a wider field of authorship. But the truth is, that did we confine our notice to the relations which obtain between the world of mind and the world of matter, we should be doing injustice to our own theme, by spoiling it of greatly more than half its richness—beside leaving unoccupied certain fertile tracts of evidence, which, if not entered upon in our division of the general work, must, as is obvious from the nature of the respective tasks, be altogether omitted in the conjunct demonstration that is now being offered to the public, of the Goodness and Wisdom of the Deity.

2. It is true that, with even but one solitary human mind in the midst of the material creation, certain relations could be traced between them that would indicate both skill and a benevolent purpose on the part of Him who constructed the framework of nature, and placed this single occupier within its confines. And, notwithstanding this limitation, there would still be preserved to us certain striking adaptations in the external system of things to the intellectual, and some too, though fewer and less noticeable, to the moral constitution of man. But, born as man obviously is for the companionship of his fellows, it must be evident that the main tendencies and aptitudes of his moral constitution should be looked for in connexion with his social relationships, with the action and re-action which take place between man and the brethren of his species. We therefore understand external nature to comprehend in it, not merely all that is external to mind, but all that is external to the individual

possessor of a human mind,—who is surrounded not only by an economy of complex and extended materialism, but who is surrounded by other men and other minds than his own. Without this generalized view of external nature, we should be left in possession of but scanty materials for evincing its adaptation to the moral constitution of man, though an ample field of observation would still lie open to us, in unfolding the aptitude of the human understanding, with its various instincts and powers, for the business of physical investigation. For the purpose then of enhancing our argument, or rather of doing but justice to it, we propose to consider not merely those relations between mind and matter, but those relations between mind and mind, the establishment of which attests a wise and beneficent contrivance. We shall thus be enabled to enter on a department of observation distinct from that of all the other labourers in this joint enterprise,—and while their provinces respectively are to trace the hand of a great and good Designer in the mechanism of the heavens, or the mechanism of the terrestrial physics, or the mechanism of various organic structures in the animal and vegetable kingdoms; it will be part of ours, more especially, to point out the evidences of a forming and presiding, and withal benevolent intelligence in the mechanism of human society.

3. We conceive of external nature then that it comprehends more than the mute and unconscious materialism, and the objective truth—it comprehends also the living society by which the possessor of a moral and intellectual constitution is surrounded. Did we exclude the latter from our regards, we should be keeping out of view a number of as wise, and certainly, in the degree that mind is of higher consideration than body, of far more beneficial and important adaptations than any which are presented to our notice in the mechanical, or chemical, or physiological departments of creation. Both in the reciprocities of domestic life, and in those wider relations, which bind large assemblages of men into political and economical systems, we shall discern the incontestable marks of a divine wisdom and care; principles or laws of human nature in virtue of which the social economy moves rightly and prosperously onward, and apart from which all would go into derangement; affinities between man and his fellows, that harmonize the individual with the general interests, and are obviously designed as provisions for the well-being both of families and nations.

4. It might help to guard us against a possible misconception, if now, at the outset of our argument, we shall distinguish between the moral constitution of man, and that moral system of doctrine which embodies in it the outer truths or principles of ethical science. The two are as distinct from each other, as are the objective and subjective in any quarter of contemplation whatever, and ought no more to be confounded than, in optics, the system of visible things with the anatomical structure of the eye. The organ which perceives or

apprehends truth is separate in reality, and should be kept separate in thought, from the truth which is apprehended; and thus it is that we should view the moral constitution of man and the moral system of virtue as diverse and distinct from each other. The one belongs to the physiology of the mind, and is collected, like all other experimental truth, by a diligent observation of facts and phenomena. The other, involving, as it does, those questions which relate to the nature of virtue, or to the origin and principles of moral obligation, directs the attention of the mind to another quarter than to its own processes, and presents us with a wholly distinct matter of contemplation. The acts of moral judgment or feeling should not be confounded with the objects of moral judgment or feeling, any more, in fact, than the rules of logic should be confounded with the laws which govern the procedure of the human understanding. The question, "what is virtue?" or "what is that which constitutes virtue?" is one thing. The question, "what is the mental process by which man takes cognisance of virtue?" is another. They are as distinct from each other as are the principles of good reasoning from the processes of the reasoning faculty. It is thus that the mental philosophy, whose proper and legitimate province is the physics of the mind, should be kept distinct from logic and ethics, and the philosophy of taste. The question, "what is beautiful in scenery?" or "what is right in character?" or "what is just in argument?" is distinct from the question, "what is the actual and historical procedure of the mind in addressing itself to these respective objects of contemplation?" as distinct, indeed, as the question of "*Quid est*" is from "*Quid oportet*;" or as the question of "what is" from "what ought to be."* A sound objective system of ethics may be framed, irrespective of any attention that we give to man's moral constitution. A sound system of logic may be framed, irrespective of any attention that we give to man's intellectual constitution. And on the other hand, however obscure or unsettled these sciences may still be; and more especially, whatever controversies may yet obtain respecting the nature and the elementary principles of virtue,—such notwithstanding, may be the palpable and ascertained facts in the nature and history of subjective man, that, both on his mental constitution, and on the adaptation thereto of external nature, there might remain a clear and unquestionable argument for the power, and wisdom, and goodness of God.

5. Having thus referred our argument, not to the constitution of morality in the abstract, but to the constitution of man's moral na-

* See the Introduction of Sir James Mackintosh's Ethical Dissertation. "The purpose of the physical sciences, throughout all their provinces, is to answer the question "*What is?*" The purpose of the moral sciences is to answer the question, "*What ought to be?*"—It should be well kept in view, that mental philosophy is one province of the physical sciences, and belongs to the first of these two departments, being distinct from moral philosophy, which forms the second of them.

ture—a concrete and substantive reality, made up of facts that come within the domain of observation; let us now consider how it is that natural theology proceeds with her demonstrations, on other constitutions and other mechanisms in creation, that we may learn from this in what manner we should commence and prosecute our labours, on that very peculiar, we had almost said, untried field of investigation which has been assigned to us.

6. The chief then, or at least the usual subject-matter of the argument for the wisdom and goodness of God, is the obvious adaptation wherewith creation teems, throughout all its borders, of means to a beneficial end. And it is manifest that the argument grows in strength with the number and complexity of these means. The greater the number of independent circumstances which must meet together for the production of a useful result—then, in the actual fact of their concurrence, is there less of probability for its being the effect of chance, and more of evidence for its being the effect of design. A beneficent combination of three independent elements is not so impressive or so strong an argument for a divinity, as a similar combination of six or ten such elements. And every mathematician, conversant in the doctrine of probabilities, knows how with every addition to the number of these elements, the argument grows in force and intensity, with a rapid and multiple augmentation—till at length, in some of the more intricate and manifold conjunctions, those more particularly having an organic character and structure, could we but trace them to an historical commencement, we should find, on the principles of computation alone, that the argument against their being fortuitous products, and for their being the products of a scheming and skilful artificer, was altogether overpowering.

7. We might apply this consideration to various departments in nature. In astronomy, the independent elements seem but few and simple, which must meet together for the composition of a planetarium. One uniform law of gravitation, with a force of projection impressed by one impulse on each of the bodies, could suffice to account for the revolutions of the planets round the sun, and of the satellites around their primaries, along with the diurnal revolution of each, and the varying inclinations of the axes to the planes of their respective orbits. Out of such few contingencies, the actual orrery of the heavens has been framed. But in anatomy, to fetch the opposite illustration from another science, what a complex and crowded combination of individual elements must first be effected, ere we obtain the composition of an eye,—for the completion of which mechanism, there must not only be a greater number of separate laws, as of refraction and muscular action and secretion; but a vastly greater number of separate and distinct parts, as the lenses, and the retina, and the optic nerve, and the eye-lid and eye-lashes, and the various muscles wherewith this delicate organ is so curiously beset, and each of which is indispensable to its perfection,

or to the right performance of its functions. It is passing marvellous that we should have more intense evidence for a God in the construction of an eye, than in the construction of the mighty planetarium—or that, within less than the compass of a handbreadth, we should find in this lower world a more pregnant and legible inscription of the Divinity, than can be gathered from a broad and magnificent survey of the skies, lighted up though they be, with the glories and the wonders of astronomy.

8. But while nothing can be more obvious than that the proof for design in any of the natural formations, is the stronger, in proportion to the number of separate and independent elements which have been brought together, and each of which contributes essentially to its usefulness—we have long held it of prime importance to the theistical argument, that clear exhibition should be made of a distinction not generally adverted to, which obtains between one set of these elements and another. We shall illustrate this by a material, ere we apply it to a mental workmanship.

9. There is, then, a difference of great argumentative importance in this whole question, between the Laws of Matter and the Dispositions of matter. In astronomy, for example, when attending to the mechanism of the planetary system, we should instance at most but two laws—the law of gravitation; and perhaps the law of perseverance, on the part of all bodies, whether in a state of rest or of motion, till interrupted by some external cause. But had we to state the dispositions of matter in the planetary system, we should instance a greater number of particulars. We should describe the arrangement of its various parts, whether in respect to situation, or magnitude, or figuré—as the position of a large and luminous mass in the centre, and of the vastly smaller but opaque masses which circulated around it, but at such distances as not to interfere with each other, and of the still smaller secondary bodies which revolved about the planets: And we should include in this description the impulses in one direction, and nearly in one plane, given to the different moving bodies; and so regulated, as to secure the movement of each, in an orbit of small eccentricity. The dispositions of matter in the planetary system were fixed at the original setting up of the machine. The laws of matter were ordained for the working of the machine. The former, that is the dispositions, make up the frame-work, or what may be termed the apparatus of the system. The latter, that is the laws, uphold the performance of it.

10. Now the tendency of atheistical writers is to reason exclusively on the laws of matter, and to overlook its dispositions. Could all the beauties and benefits of the astronomical system be referred to the single law of gravitation, it would greatly reduce the strength of the argument for a designing cause. La Place, as if to fortify still more the atheism of such a speculation, endeavoured to demonstrate of this law—that, in respect of its being inversely proportional

to the square of the distance from the centre, it is an essential property of matter. La Grange had previously established—that but for such a proportion, or by the deviation of a thousandth part from it, the planetary system would go into derangement—or, in other words, that the law, such as it is, was essential to the stability of the present mundane constitution. La Place would have accredited the law, the unconscious and unintelligent law, that thing according to him of blind necessity, with the whole of this noble and beautiful result—overlooking what La Grange held to be indispensable as concurring elements in his demonstration of it—certain dispositions along with the law—such as the movement of all the planets, first in one direction, second nearly in one plane, and then in nearly circular orbits. We are aware that according to the discoveries, or rather perhaps to the guesses of some later analysts, the three last circumstances might be dispensed with; and yet notwithstanding, the planetary system, its errors still remaining periodical, would in virtue of the single law oscillate around a mean state that should be indestructible and everlasting. Should this come to be a conclusively settled doctrine in the science, it will extenuate, we admit, the argument for a designing cause in the formation of the planetarium. But it will not annihilate that argument—for there do remain certain palpable utilities in the dispositions as well as laws of the planetary system, acknowledged by all the astronomers; such as the vastly superior weight and quantity of matter accumulated in its centre, and the local establishment there of that great fountain of light and heat from which the surrounding worlds receive throughout the whole of their course an equable dispensation. What a maladjustment would it have been, had the luminous and the opaque matter changed places in the firmament; or the planets, by the eccentricity of their orbits, been subject to such vicissitudes of temperature, as would certainly, in our own at least, have entailed destruction both on the animal and vegetable kingdoms.

11. But whatever defect or doubtfulness of evidence there may be in the mechanism of the heavens—this is amply made up for in a more accessible mechanism, near at hand. If either the dispositions of matter in the former mechanism be so few, or the demonstrable results of its single law be so independent of them, that the agency of design rather than of necessity or chance be less manifest than it otherwise would be in the astronomical system; nothing on the other hand can exceed the force and concentration of that proof, which is crowded to so marvellous a degree of enhancement within the limits of the anatomical system. It is this which enables us to draw so much weightier an argument for a God, from the construction of an eye than from the construction of a planetarium. And here it is quite palpable, that it is in the dispositions of matter, more than in the laws of matter, where the main strength of the argument lies, though we hear much more of the wisdom of Nature's laws, than

of the wisdom of her collocations.* Now it is true that the law of refraction is indispensable to the faculty of vision; but the laws indispensable to this result are greatly outnumbered by the dispositions which are indispensable to it—such as the rightly sized and shaped lenses of the eye; and the rightly placed retina spread out behind them, and at the precise distance where the indispensable picture of external nature might be formed, and presented as it were for the information of the occupier within; and then, the variety and proper situation of the numerous muscles, each entrusted with an important function, and all of them contributing to the power and perfection of this curious and manifoldly complicated organ. It is not so much the endowment of matter with certain properties, as the arrangement of it into certain parts, that bespeaks here the hand of an artist; and this will be found true of the anatomical structure in all its departments. It is not the mere chemical property of the gastric juice that impresses the belief of contrivance; but the presence of the gastric juice, in the very situation whence it comes forth to act with advantage on the food, when received into the stomach, and there submitted to a digestive process for the nourishment of the animal economy. It is well to distinguish these two things. If we but say of matter that it is furnished with such powers as make it subservient to many useful results, we keep back the strongest and most unassailable part of the argument for a God. It is greatly more pertinent and convincing to say of matter, that it is distributed into such parts as to ensure a right direction and a beneficial application for its powers. It is not so much in the establishment of certain laws for matter, that we discern the aims or the purposes of intelligence, as in certain dispositions of matter, that put it in the way of being usefully operated upon by the laws. Insomuch, that though we conceded to the atheist, the eternity of matter, and the essentially inherent character of all its laws—we could still point out to him, in the manifold adjustments of matter, its adjustments of

* This distinction between the laws and collocations of matter is overlooked by atheistical writers, as in the following specimen from the "Système de la Nature" of Mirabaud. "These prejudiced dreamers," speaking of believers in a God, "are in an ecstasy at the sight of the periodical motion of the planets; at the order of the stars; at the various productions of the earth; at the astonishing harmony in the component parts of animals. In that moment, however, they forget the laws of motion; the power of gravitation; the forces of attraction and repulsion; they assign all these striking phenomena to unknown causes, of which they have no one substantive idea."

When Professor Robison felt alarmed by the attempted demonstration of La Place, that the law of gravitation was an essential property of matter, lest the cause of natural theology should be endangered by it—he might have recollected that the main evidence for a Divinity lies not in the laws of matter, but in their collocations—because of the utter inadequacy in the existing laws to have originated the existing collocations of the material world. So that if ever a time was, when these collocations were not—there is no virtue in the laws that can account for their commencement, or that supersedes the fiat of a God.

place, and figure, and magnitude, the most impressive signatures of a Deity. And what a countless variety of such adjustments within the compass of an animal, or even a vegetable frame-work. In particular, what an amount and condensation of evidence for a God in the workmanship of the human body. What bright and convincing lessons of theology might man, (would he but open his eyes,) read on his own person—that microcosm of divine art, where as in the sentences of a perfect epitome, he might trace in every lineament or member the finger and authorship of the Godhead.

12. In the performances of human art, the argument for design that is grounded on the useful dispositions of matter, stands completely disentangled from the argument that is grounded on the useful laws of matter—for in every implement or piece of mechanism constructed by the hands of man, it is in the latter apart from the former, that the indications of contrivance wholly and exclusively lie. We do not accredit man with the establishment of any laws for matter—yet he leaves enough by which to trace the operations of his intelligence in the collocations of matter. He does not give to matter any of its properties; but he arranges it into parts—and by such arrangement alone, does he impress upon his workmanship the incontestable marks of design; not in that he has communicated any powers to matter, but in that he has intelligently availed himself of these powers, and directed them to an obviously beneficial result. The watch-maker did not give its elasticity to the main-spring, nor its regularity to the balance wheel, nor its transparency to the glass, nor the momentum of its varying forces to the levers of his mechanism—yet is the whole replete with the marks of intelligence notwithstanding, announcing throughout the hand of a maker who had an eye on all these properties, and assigned the right place and adjustment to each of them, in fashioning and bringing together the parts of an instrument for the measurement and the indication of time. Now, the same distinction can be observed in all the specimens of natural mechanism. It is true that we accredit the author of these with the creation and laws of matter, as well as its dispositions; but this does not hinder its being in the latter and not in the former, where the manifestations of skill are most apparent, or where the chief argument for a divinity lies. The truth is, that mere laws, without collocations, would have afforded no security against a turbid and disorderly chaos. One can imagine of all the substantive things which enter into the composition of a watch, that they may have been huddled together, without shape, and without collocation, into a little chaos, or confused medley;—where, in full possession of all the properties which belong to the matter of the instrument, but without its dispositions, every evidence of skill would have been wholly obliterated. And it is even so with all the substantive things which enter into the composition of a world. Take but their forms and collocations away from them, and this goodly

universe would instantly lapse into a heaving and disorderly chaos—yet without stripping matter of any of its properties or powers. There might still, though operating with random and undirected activity, be the laws of impulse, and gravitation, and magnetism, and temperature, and light, and the forces of chemistry, and even those physiological tendencies, which, however abortive in a state of primitive rudeness, or before the spirit of a God moved on the face of the waters, waited but a right distribution of the parts of the matter, to develop into the full effect and establishment of animal and vegetable kingdoms. The thing wanted for the evolution of this chaos into an orderly and beneficial system is not the endowing of matter with right properties; but the forming of it into things of right shape and magnitude, and the marshalling of these into right places. This last alone would suffice for bringing harmony out of confusion; and, apart altogether from the first, or, without involving ourselves in the metaphysical obscurity of those questions which relate to the origination of matter and to the distinction between its arbitrary and essential properties, might we discern, in the mere arrangements of matter, the most obvious and decisive signatures of the artist hand which has been employed on it.

13. That is a fine generalization by the late Professor Robison, of Edinburgh, which ranges all philosophy into two sciences—one the science of contemporaneous nature; the other, the science of successive nature. When the material world is viewed according to this distinction, the whole science of its contemporaneous phenomena is comprehended by him under the general name of Natural History, which takes cognisance of all those characters in external nature that exist together at the instant, and which may be described without reference to time—as smell, and colour, and size, and weight, and form, and relation of parts, whether of the simple inorganic or more complex organic structures. But when the elements of time and motion are introduced, we are then presented with the phenomena of successive nature; and the science that embraces these is, in contradistinction to the former, termed Natural Philosophy. This latter science may be separated or subdivided further into natural philosophy, strictly and indeed usually so called, whose province it is to investigate those changes which take effect in bodies by motions that are sensible and measurable; and chemistry, or the science of those changes which take effect in bodies by motions which are not sensible, or, at least, not measurable, and which cannot therefore be made the subjects of mathematical computation or reasoning. This last, again, is capable of being still further partitioned into the science which investigates the changes effected by means of insensible motion in all inorganic matter, or chemistry strictly and usually so called; and the science of physiology, whose province it is to investigate the like changes that take place in organic bodies, whether of the animal or vegetable kingdoms.

14. Or, the distinction between these two sciences of contemporaneous and successive nature may otherwise be stated thus. The one, or natural history, is conversant with objects—the other, or natural philosophy in its most comprehensive meaning, is conversant with events. It is obvious that the dispositions of matter come within the province of the former science—while the laws of matter, or the various moving forces by which it is actuated, fall more properly under the inquiries of the latter science. Now, adopting this nomenclature, we hold it a most important assertion for the cause of natural theology, that should all the present arrangements of our existing natural history be destroyed, there is no power in the laws of our existing natural philosophy to replace them. Or, in other words, if ever a time was, when the structure and dispositions of matter, under the present economy of things were not—there is no force known in nature, and no combination of forces that can account for their commencement. The laws of nature may keep up the working of the machinery—but they did not and could not set up the machine. The human species, for example, may be upholden, through an indefinite series of ages, by the established law of transmission—but were the species destroyed, there are no observed powers of nature by which it could again be originated. For the continuance of the system and of all its operations, we might imagine a sufficiency in the laws of nature; but it is the first construction of the system which so palpably calls for the intervention of an artificer, or demonstrates so powerfully the fiat and finger of a God.

15. This distinction between nature's laws and nature's collocations is mainly lost sight of in those speculations of geology, the object of which is to explain the formation of new systems emerging from the wreck of old ones. They proceed on the sufficiency of nature's laws for building up the present economy of things out of the ruins of a former economy, which the last great physical catastrophe on the face of our earth had overthrown. Now, in these ruins, viewed as materials for the architecture of a renovated world, there did reside all those forces, by which the processes of the existing economy are upholden; but the geologists assign to them a function wholly distinct from this, when they labour to demonstrate, that by laws, and laws alone, the framework of our existing economy was put together. It is thus that they would exclude the agency of a God from the transition between one system, or one formation, and another, although it be precisely at such transition when this agency seems most palpably and peculiarly called for. We feel assured that the necessity for a divine intervention, and, of course, the evidence of it would have been more manifest, had the distinction between the laws of matter and its collocations been more formally announced, or more fully proceeded on by the writers on natural theism. And yet it is a distinction that must have been present to the mind of our great Newton, who expressly affirms that

a mechanism of wonderful structure could not arise by the mere laws of nature. In his third printed letter to Bentley, he says, that "the growth of *new systems* out of *old ones*, without the mediation of a divine power, seems to me apparently absurd;" and that "the system of nature was *set in order* in the beginning, with respect to size, figure, proportions, and properties, by the counsels of God's own intelligence." In the last extracts, by his admission of the properties along with the dispositions of matter, he somewhat confounds or disguises again the important distinction which, at times, he had clearly in his view.*

16. But one precious fruit of the recent geological discoveries may be gathered from the testimony which they afford to the destruction of so many terrestrial economies now gone by, and the substitution of the existing one in their place. If there be truth at all in the speculations of this science, there is nothing which appears to have been more conclusively established by them, than a definite origin or commencement for the present animal and vegetable races. Now we know what it is which upholds the whole of the physiological system that is now before our eyes,—even the successive derivation of each individual member from a parent of its own likeness; but we see no force in nature, and no complication of forces which can tell us what it was that originated the system. It is at this passage in the history of nature, where we meet with such pregnant evidence for the interposition of a designing cause,—an evidence, it will be seen, of prodigious density and force, when we compute the immense number and variety of those aptitudes, whether of form or magnitude or relative position, which enter into the completion of an organic structure. It is in the numerical superiority of the distinct collocations to the distinct laws of matter, that the superior evidence of the former lies. We do not deny that there is argument for a God in the number of beneficial, while, at the same time, distinct and independent laws wherewith matter is endowed. We only affirm a million-fold intensity of argument in the indefinitely greater number of beneficial, and at the same time distinct and independent number of collocations whereinto matter has been arranged. In this respect the human body may be said to present a more close and crowded and multifarious inscription of the divinity, than any

* Towards the end of the third book of Newton's Optics, we have the following very distinct testimony upon this subject: "For it became him who created them to set them in order. And if he did so, it is unphilosophical to seek for any other origin of the world, or to pretend that it might arise out of a chaos by the mere laws of nature; though being once formed, it may continue by those laws for many ages."

This disposition to resolve the collocations into the laws of nature proves, in the expressive language of Granville Penn, how strenuously, not "physical science, but only some of its disciples have laboured to exclude the *Creator* from the *details* of his own creation; straining every nerve of ingenuity to ascribe them *all* to *secondary causes*."

single object within the compass of visible nature. It is instinct throughout with the evidence of a builder's hand; and thus the appropriate men of science who can expound those dispositions of matter which constitute the anatomy of its framework, and which embrace the physiology of its various processes, are on secure and firm vantage ground for an impressive demonstration.

17. Now there are many respects in which the evidence for a God, given forth by the constitution of the human body, differs from the evidence given forth by the constitution of the human spirit. It is with the latter evidence that we have more peculiarly to deal; but at present we shall only advert to a few of its distinct and special characteristics. The subject will at length open into greater detail, and developement before us,—yet a brief preliminary exposition may be useful at the outset, should it only convey some notion of the difficulties and particularities of the task which has been put into our hands.

18. A leading distinction between the material and the mental fabrications is, the far greater complexity of the former, at least greater to all human observation. Into that system of means which has been formed for the object of seeing, there enter at least twenty separate contingencies, the absence of any one of which would either derange the proper function of the eye, or altogether destroy it. We have no access to aught like the observation of a mental structure, and all of which our consciousness informs us is a succession of mental phenomena. Now in these we are sensible of nothing but a very simple antecedent followed up, and that generally on the instant, by a like simple consequent. We have the feeling and still more the purpose of benevolence, followed up by complacency. We have the feeling or purpose, and still more the execution of malignity, or rather the recollection of that execution, followed up by remorse. However manifold the apparatus may be which enables us to see an external object,—when the sight itself, instead of the consequent in a material succession, becomes the antecedent in a mental one; or, in other words, when it passes from a material to a purely mental process; then, as soon, does it pass from the complex into the simple; and, accordingly, the sight of distress is followed up, without the intervention of any curiously elaborated mechanism that we are at all conscious of, by an immediate feeling of compassion. These examples will, at least, suffice to mark a strong distinction between the two inquiries, and to show that the several arguments drawn from each must at least be formed of very different materials.

19. There are two distinct ways in which the mind can be viewed, and which constitute different modes of conception, rather than diversities of substantial and scientific doctrine. The mind may either be regarded as a congeries of different faculties; or as a simple and indivisible substance, with the susceptibility of passing

into different states. By the former mode of viewing it, the memory, and the judgment, and the conscience, and the will, are conceived of as so many distinct but co-existent parts of mind, which is thus represented to us somewhat in the light of an organic structure, having separate members, each for the discharge of its own appropriate mental function or exercise. By the latter, which we deem also the more felicitous mode of viewing it, these distinct mental acts, instead of being referred to distinct parts of the mind, are conceived of as distinct acts of the whole mind,—insomuch that the whole mind remembers, or the whole mind judges, or the whole mind wills, or, in short, the whole mind passes into various intellectual states or states of emotion, according to the circumstances by which at the time it is beset, or to the present nature of its employment. We might thus either regard the study of mind as a study in contemporaneous nature; and we should then, in the delineation of its various parts, be assigning to it a natural history,—or we might regard the study of mind as a study in successive nature; and we should then, in the description of its various states, be assigning to it a natural philosophy. When such a phrase as the anatomy of the human mind is employed by philosophers, we may safely guess that the former is the conception which they are inclined to form of it.* When such a phrase again as the physiology of the human mind is made use of, the latter is the conception by which, in all probability, it has been suggested. It is thus that Dr. Thomas Brown designates the science of mind as mental physiology. With him, in fact, it is altogether a science of sequences, his very analysis being the analysis of results, and not of compounds.

20. Now, in either view of our mental constitution there is the same strength of evidence for a God. It matters not for this, whether the mind be regarded as consisting of so many useful parts, or as endowed with as many useful properties. It is the number, whether the one or other, of these—out of which the product is formed of evidence for a designing cause. The only reason why the useful dispositions of matter are so greatly more prolific of this evidence than the useful laws of matter, is, that the former so greatly outnumber the latter. Of the twenty independent circumstances which enter into beneficial concurrence in the formation of an eye, that each of them should be found in a situation of optimism, and none of them occupying either an indifferent or a hurtful position—it is this which speaks so emphatically against the hypothesis of a random distribution, and for the hypothesis of an intelligent order. Yet this is but one out of the many like specimens, wherewith the animal economy thickens and teems in such marvellous profusion. By the doctrine of probabilities, the mathematical evidence, in this question

* It is under this conception too that writers propose to lay down a map of the human faculties.

between the two suppositions of intelligence or chance, will be found, even on many a single organ of the human framework, to preponderate vastly more than a million-fold on the side of the former. We do not affirm of the human mind that it is so destitute of all complication and variety, as to be deficient altogether in this sort of evidence. Let there be but six laws or ultimate facts in the mental constitution, with the circumstance of each of them being beneficial; and this of itself would yield no inconsiderable amount of precise and calculable proof, for our mental economy being a formation of contrivance, rather than one that is fortuitous or of blind necessity. It will at once be seen, however, why mind, just from its greater simplicity than matter, should contribute so much less to the support of natural theism, of that definite and mathematical evidence which is founded on combination.

21. But, although in the mental department of creation, the argument for a God that is gathered out of such materials, is not so strong as in the other great department—yet it does furnish a peculiar argument of its own, which, though not grounded on mathematical data, and not derived from a lengthened and logical process of reasoning, is of a highly effective and practical character notwithstanding. It has not less in it of the substance, though it may have greatly less in it of the semblance of a demonstration, that it consists of but one step between the premises and the conclusion. It is briefly, but cannot be more clearly and emphatically expressed than in the following sentence.—“He that formed the eye, shall he not see? He that planted the ear, shall he not hear? He that teacheth man knowledge, shall he not know?” That the parent cause of intelligent beings shall be itself intelligent is an aphorism, which, if not demonstrable in the forms of logic, carries in the very announcement of it a challenging power over the acquiescence of all spirits. It is a thing of instant conviction, as if seen in the light of its own evidence, more than a thing of lengthened and laborious proof. It may be stigmatized as a mere impression—nevertheless the most of intellects go as readily along with it, as they would from one *contiguous* step to another of many a stately argumentation. If it cannot be exhibited as the conclusion of a syllogism, it is because of its own inherent right to be admitted there as the major proposition. To proscribe every such truth, or to disown it from being truth, merely because incapable of deduction, would be to cast away the first principles of all reasoning. It would banish the authority of intuition, and so reduce all philosophy and knowledge to a state of universal scepticism—for what is the first departure of every argument but an intuition, and what but a series of intuitions are its successive stepping-stones? We should soon involve ourselves in helpless perplexity and darkness, did we insist on everything being proved and on nothing being assumed—for valid assumptions are the materials of truth, and the only office of argument is to

weave them together into so many pieces of instruction for the bettering or enlightening of the species.

22. That blind and unconscious matter cannot, by any of her combinations, evolve the phenomena of mind, is a proposition seen in its own immediate light, and felt to be true with all the speed and certainty of an axiom. It is to such truth, as being of instant and almost universal consent, that, more than to any other, we owe the existence of a natural theology among men: yet, because of the occult mysticism wherewith it is charged, it is well that ours is a case of such rich and various argument; that in her service we can build up syllogisms, and expatiate over wide fields of induction, and amass stores of evidence, and, on the useful dispositions of matter alone, can ground such large computations of probability in favour of an intelligent cause or maker for all things, as might silence and satisfy the reasoners.

23. But we forget that the object of the joint compositions which enter into this work, is not properly to demonstrate the being but the attributes of God, and more especially His power, and wisdom, and goodness. We start from that point at which the intuitions and proofs of the question have performed their end of convincing man that God is; and from this point, we set forth on an inquiry into the character which belongs to him. Now this is an inquiry which the constitution of the mind, and the adaptation of that constitution to the external world, are pre-eminently fitted to illustrate. We hold that the material universe affords decisive attestation to the natural perfections of the Godhead, but that it leaves the question of his moral perfections involved in profoundest mystery. The machinery of a serpent's tooth, for the obvious infliction of pain and death upon its victims, may speak as distinctly for the power and intelligence of its Maker as the machinery of those teeth which, formed and inserted for simple mastication, subserve the purposes of a bland and beneficent economy. An apparatus of suffering and torture might furnish as clear an indication of design, though a design of cruelty, as does an apparatus for the ministration of enjoyment furnish the indication also of design, but a design of benevolence. Did we confine our study to the material constitution of things, we should meet with the enigma of many perplexing and contradictory appearances. We hope to make it manifest, that in the study of the mental constitution, this enigma is greatly alleviated, if not wholly done away; and, at all events, that within our peculiar province there lie the most full and unambiguous demonstrations, which nature hath anywhere given to us, both of the benevolence and the righteousness of God.

24. If, in some respects, the phenomena of mind tell us less decisively than the phenomena of matter, of the existence of God, they tell us far more distinctly and decisively of His attributes. We have already said that, from the simplicity of the mental system, we met with less there of that evidence for design which is founded on com-

ination, or on that right adjustment and adaptation of the numerous particulars, which enter into a complex assemblage of things, and which are essential to some desirable fulfilment. It is not, therefore, through the medium of this particular evidence—the evidence which lies in combination; that the phenomena and processes of mind are the best for telling us of the Divine existence. But if otherwise, or previously told of this, we hold them to be the best throughout all nature for telling us of the Divine character. For if once convinced, on distinct grounds, that God is, it matters not how simple the antecedents or the consequents of any particular succession may be. It is enough that we know what the terms of the succession are, or what the effect is wherewith God wills any given thing to be followed up. The character of the ordination, and so the character of the ordainer, depends on the terms of the succession; and not on the nature of that intervention or agency, whether more or less complex, by which it is brought about. And should either term of the succession, either the antecedent or consequent, be some moral feeling, or characteristic of the mind, then the inference comes to be a very distinct and decisive one. That the sight of distress, for example, should be followed up by compassion, is an obvious provision of benevolence, and not of cruelty, on the part of Him who ordained our mental constitution. Again, that a feeling of kindness in the heart should be followed up by a feeling of complacency in the heart, that in every virtuous affection of the soul there should be so much to gladden and harmonize it, that there should always be peace within when there is conscious purity or rectitude within; and, on the other hand, that malignity and licentiousness, and the sense of any moral transgression whatever, should always have the effect of discomfiting, and sometimes even of agonizing the spirit of man—that such should be the actual workmanship and working of our nature, speaks most distinctly, we apprehend, for the general righteousness of Him who constructed its machinery and established its laws. An omnipotent patron of vice would have given another make, and a moral system with other and opposite tendencies to the creatures whom he had formed. He would have established different sequences; and, instead of that oil of gladness which now distils, as if from a secret spring of satisfaction, upon the upright; and, instead of that bitterness and disquietude which are now the obvious attendants on every species of delinquency, we should have had the reverse phenomena of a reversely constituted species, whose minds were in their state of wildest disorder when kindling with the resolves of highest excellence; or were in their best and happiest, and most harmonious mood, when brooding over the purposes of dishonesty, or frenzied with the passions of hatred and revenge.

25. In this special track of observation, we have at least the means or data for constructing a far more satisfactory demonstration of the divine attributes, than can possibly be gathered, we think,

from the ambiguous phenomena of the external world. In other words, it will be found that the mental phenomena speak more distinctly and decisively for the character of God than do the material phenomena of creation. And it should not be forgotten that whatever serves to indicate the character, serves also to confirm the existence of the Divine Being. For this character, whose signatures are impressed on Nature, is not an abstraction, but must have residence on a concrete and substantive Being, who hath communicated a transcript of Himself to the workmanship of His own hands. It is thus, that, although in our assigned department there is a greater poverty of evidence for a God, in as far as that evidence is grounded on a skilful disposition of parts,—yet, in respect of another kind of evidence, there is no such poverty; for, greatly more replete as we hold our special department to be with the unequivocal tokens of a moral character, we, by that simple but strong ligament of proof which connects a character with an existence, can, in the study of mind alone, find a firm stepping-stone to the existence of a God. Our universe is sometimes termed the mirror of Him who made it. But the optical reflection, whatever it may be, must be held as indicating the reality which gave it birth; and, whether we discern there the expression of a reigning benevolence, or a reigning justice, these must not be dealt with as the aerial or the fanciful personifications of qualities alone, but as the substantial evidences of a just and benevolent, and, withal, a living God.

26. But, in the prosecution of our assigned task, we shall, after all, meet with much of that evidence, which lies in the manifold, and, withal, happy conjunction of many individual things, by the meeting together of which, some distinctly beneficial end is accomplished, brought about in that one way and in no other. For it ought further to be recollected, that, simple as the constitution of the human mind is, and proportionally unfruitful, therefore, as it may be of that argument for a God, which is founded on the right assortment and disposition of many parts, or even of many principles; yet, on studying the precise terms of the commission which has been put into our hands, it will be found that the materials even of this peculiar argument lie abundantly within our province. For it is not strictly the mental constitution of man which forms the subject of our prescribed essay, but the adaptation to that constitution of external nature. We have to demonstrate, not so much that the mind is rightly constituted in itself, as that the mind is rightly placed in a befitting theatre for the exercise of its powers. It is to demonstrate that the world and its various objects are suited to the various capacities of this inhabitant—this moral and intelligent creature, of whom we have to prove that the things which are around him bear a fit relation to the laws or the properties which are within him. There is ample room here for the evidence of collocation. Yet there remains this distinction between the mental and the corporeal economy of man, that

whereas the evidence is more rich and manifold in the bodily structure itself, than even in its complex and numerous adaptations to the outer world;* the like evidence, in our peculiar department, is meagre, as afforded by the subjective mind, when compared with the evidence of its various adjustments and fitnesses to the objective universe around it, whether of man's moral constitution to the state of human society, or of his intellectual to the various objects of physical investigation.

27. The great object of philosophy is to ascertain the simple or ultimate principles, into which all the phenomena of nature may by analysis be resolved. But it often happens that in this attempt she stops short at a secondary law, which might be demonstrated by further analysis to be itself a complex derivative of the primitive or elementary laws. Until this work of analysis be completed, we shall often mistake what is compound for what is simple, both in the philosophy of mind and the philosophy of matter—being frequently exposed to intractable substances or intractable phenomena in both, which long withstand every effort that science makes for their decomposition. It is thus that the time is not yet come, and may never come, when we shall fully understand, what be all the simple elements or simple laws of matter; and what be all the distinct elementary laws, or, as they have sometimes been termed, the ultimate facts in the constitution of the human mind. But we do not need to wait for this communication, ere we can trace, in either department, the wisdom and beneficence of a Deity—for many are both the material and the mental processes which might be recognised as pregnant with utility, and so, pregnant with evidence for a God, long before the processes themselves are analyzed. The truth is, that a secondary law, if it do not exhibit any additional proof of design, in a distinct useful principle, exhibits that proof in a distinct and useful disposition of parts—for, generally speaking, a secondary law is the result of an operation by some primitive law, in peculiar and new circumstances. For example, the law of the tides is a secondary law, resolvable into one more general and elementary—even the law of gravitation. But we might imagine a state of things, in which the discovery of this connexion would have been impossible,—as a sky perpetually mantled with a cloudy envelopement, which, while it did not intercept the light either of the sun or moon, still hid these bodies from our direct observation. In these circumstances, the law of the tides and the law of gravitation, though identical in themselves, could not have been identified by us; and so, we might have ascribed this wholesome agitation of the sea and of the atmosphere to a distinct power or principle in nature—affording the distinct indication of both a kind and intelligent Creator. Now this

* Yet Paley has a most interesting chapter on the adaptations of external nature to the human framework, though the main strength and copiousness of his argument lie in the anatomy of the framework itself.

inference is not annihilated—it is not even enfeebled by the discovery in question; for although the good arising from tides in the ocean and tides in the air, is not referable to a peculiar law—it is at least referable to a peculiar collocation. And this holds of all the useful secondary laws in the material world. If they cannot be alleged in evidence for the number of beneficial principles in nature—they can at least be alleged in evidence for the number of nature's beneficial arrangements. If they do not attest the multitude of useful properties, they at the least attest the multitude of useful parts in nature; and the skill, guided by benevolence which has been put forth in the distribution of them. So that long ere the philosophy of matter is perfected, or all its phenomena and its secondary laws have been resolved into their original and constituent principles—may we, in their obvious and immediate utility alone, detect as many separate evidences in nature as there are separate facts in nature, for a wise and benevolent Deity.

28. And the same will be found true of the secondary laws in the mental world, which, if not as many distinct beneficial principles in the constitution of the mind, are the effect of as many distinct and beneficial arrangements in the objects or circumstances by which it is surrounded. We have not to wait the completion of its still more subtle and difficult analysis, ere we come within sight of those varied indications of benevolent design which are so abundantly to be met with, both in the constitution of the mind itself, and in the adaptation thereto of external nature. Some there are, for example, who contend that the laws of taste are not primitive but secondary; that our admiration of beauty in material objects is resolvable into other and original emotions, and, more especially, by means of the associating principle, into our admiration of moral excellence. Let the justness of this doctrine be admitted; and its only effect on our peculiar argument is, that the benevolence of God in thus multiplying our enjoyments, instead of being indicated by a distinct law for suiting the human mind to the objects which surround it, is indicated both by the distribution of these objects and by their investment with such qualities as suit them to the previous constitution of the mind—that he hath pencilled them with the very colours, or moulded them into the very shapes which suggest either the graceful or the noble of human character; that he hath imparted to the violet its hue of modesty, and clothed the lily in its robe of purest innocence, and given to the trees of the forest their respective attitudes of strength or delicacy, and made the whole face of nature one bright reflection of those virtues which the mind and character of man had originally radiated. If it be not by the implantation of a peculiar law in mind, it is at least by a peculiar disposition of tints and forms in external nature, that he hath spread so diversified a loveliness over the panorama of visible things; and thrown so many walks of enchantment around us; and turned the sights and the sounds of rural scenery

into the ministers of so much and such exquisite enjoyment; and caused the outer world of matter to image forth in such profusion those various qualities, which at first had pleased or powerfully affected us in the inner world of consciousness and thought. It is by the modifying operation of circumstances that a primary is transmuted into a secondary law; and if the blessings which we enjoy under it cannot be ascribed to the insertion of a distinct principle in the nature of man, they can at least be ascribed to a useful disposition of circumstances in the theatre around him.

29. It is thus that philosophical discovery, which is felt by many to enfeeble the argument for a God, when it reduces two or more subordinate to simpler and anterior laws, does in fact leave that argument as entire as before—for if, by analysis, it diminish the number of beneficial properties in matter, it replaces the injury which it may be supposed to have done in this way to the cause of theism, by presenting us with as great an additional number of beneficial arrangements in nature. And further, it may not be out of place to observe, that there appear to be two distinct ways by which an artificer might make manifest the wisdom of his contrivances. He may either be conceived of, as forming a substance and endowing it with the fit properties; or as finding a substance with certain given properties, and arranging it into fit dispositions for the accomplishment of some desirable end. Both the former and the latter of these we ascribe to the divine artificer—of whom we imagine, that He is the Creator as well as the Disposer of all things. It is only the latter that we can ascribe to the human artificer, who creates no substance, and ordains no property; but finds the substance with all its properties ready made and put into his hands, as the raw material out of which he fashions his implements and rears his structures of various design and workmanship. Now it is a commonly received, and has indeed been raised into a sort of universal maxim, that the highest property of wisdom is to achieve the most desirable end, or the greatest amount of good, by the fewest possible means, or by the simplest machinery. When this test is applied to the laws of nature—then we esteem it, as enhancing the manifestation of intelligence, that one single law, as gravitation, should, as from a central and commanding eminence, subordinate to itself a whole host of most important phenomena; or that from one great and parent property, so vast a family of beneficial consequences should spring. And when the same test is applied to the dispositions, whether nature or art—then it enhances the manifestation of wisdom, when some great end is brought about with a less complex or cumbersome instrumentality, as often takes place in the simplification of machines, when, by the device of some ingenious ligament or wheel, the apparatus is made equally, perhaps more effective, whilst less unwieldy or less intricate than before. Yet there is one way in which, along with an exceeding complication in the mechanism, there might be given

the impression, of the very highest skill and capacity having been put forth on the contrivance of it. It is when, by means of a very operose and complex instrumentality, the triumph of art has been made all the more conspicuous, by a very marvellous result having been obtained out of very unpromising materials. It is true, that, in this case too, a still higher impression of skill would be given, if the same or a more striking result were arrived at, even after the intricacy of the machine had been reduced, by some happy device, in virtue of which, certain of its parts or circumvolutions had been superseded; and thus, without injury to the final effect, so much of the complication had been dispensed with. Still, however, the substance, whether of the machine or the manufacture, may be conceived so very intractable as to put an absolute limit on any further simplification, or as to create an absolute necessity for all the manifold contrivance which had been expended on it. When this idea predominates in the mind—then all the complexity which we may behold does not reduce our admiration of the artist, but rather deepens the sense that we have, both of the reconditeness of his wisdom, and of the wondrous vastness and variety of his resources. It is the extreme wideness of the contrast, between the sluggishness of matter and the fineness of the results in physiology, which so enhances our veneration for the great Architect of Nature, when we behold the exquisite organizations of the animal and vegetable kingdoms.* The two exhibitions are wholly distinct from each other—yet each of them may be perfect in its own way. The first is held forth to us, when one law of pervading generality is found to scatter a myriad of beneficent consequences in its train. The second is held forth, when, by an infinite complexity of means, a countless variety of expedients with their multiform combinations, some one design, such as the upholding of life in plants or animals is accomplished. Creation presents us in marvellous profusion with specimens of both these—at once confirming the doctrine, and illustrating the significance of the expression in which Scripture hath conveyed it to us, when it tells of the *manifold* wisdom of God.

30. But while, on a principle already often recognised, this multitude of necessary conditions to the accomplishment of a given end, enhances the argument for a God, because each separate condition reduces the hypothesis of chance to a more violent improbability than before; yet it must not be disguised that there is a certain transcendental mystery which it has the effect of aggravating, and which it leaves unresolved. We can understand the complex machinery and the circuitous processes to which a human artist must resort, that he might overcome the else uncomplying obstinacy of inert matter, and bend it in subserviency to his special designs. But

* Dr. Paley would state the problem thus. The laws of matter being given, so to organize it, as that it shall produce or sustain the phenomena, whether of vegetation or of life.

that the Divine artist who first created the matter and ordained its laws, should find the same complication necessary for the accomplishment of his purposes; that such an elaborate workmanship, for example, should be required to establish the functions of sight and hearing in the animal economy, is very like the lavish or ostensible ingenuity of a Being employed in conquering the difficulty which himself had raised. It is true, the one immediate purpose is served by it which we have just noticed,—that of presenting, as it were, to the eye of inquirers a more manifold inscription of the Divinity. But if, instead of being the object of inference, it had pleased God to make himself the object of a direct manifestation, then for the mere purpose of becoming known to his creatures, this reflex or circuitous method of revelation would have been altogether uncalled for. That under the actual system of creation, and with its actual proofs, he has made his existence most decisively known to us, we most thankfully admit. But when question is made between the actual and the conceivable systems of creation which God might have emanated, we are forced to confess, that the very circumstances which, in the existing order of things, have brightened and enhanced the evidence of His being, have also cast a deeper secrecy over what may be termed the general policy of His government and ways. And this is but one of the many difficulties, which men of unbridled speculation and unobservant of that sound philosophy that keeps within the limits of human observation, will find it abundantly possible to conjure up on the field of natural theism. It does look an impracticable enigma that the Omnipotent God, who could have grafted all the capacities of thought and feeling on an elementary atom, should have deemed fit to incorporate the human soul in the midst of so curious and complicated a framework. For what a variegated structure is man's animal economy. What an apparatus of vessels and bones and ligaments. What a complex mechanism. What an elaborate chemistry. What a multitude of parts in the anatomy, and of processes in the physiology of this marvellous system. What a medley, we had almost said, what a package of contents. What an unwearied play of secretions and circulations and other changes incessant and innumerable. In short, what a laborious complication; and all to uphold a living principle, which, one might think, could by a simple fiat of omnipotence, have sprung forth at once from the great source and centre of the spiritual system, and mingled with the world of spirits—just as each new particle of light is sent forth by the emanation of a sunbeam, to play and glisten among the fields of radiance.

31. But to recall ourselves from this digression among the possibilities of what might have been, to the realities of the mental system, such as it actually is. Ere we bring the very general observations of this chapter to a close, we would briefly notice an analogy between the realities of the mental and those of the corporeal system. The

inquirers into the latter have found it of substantial benefit to their science, to have mixed up with the prosecution of it a reference to final causes. Their reasoning on the likely uses of a part in anatomy, has, in some instances, suggested or served as a guide to speculations, which have been at length verified by a discovery. We believe, in like manner, that reasoning on the likely or obvious uses of a principle in the constitution of the human mind, might lead, if not to the discovery, at least to the confirmation of important truth—not perhaps in the science itself, but in certain of the cognate sciences which stand in no very distant relation to it. For example, we think it should rectify certain errors which have been committed both in jurisprudence and political economy, if it can be demonstrated that some of the undoubted laws of human nature are traversed by them; and so, that violence is thereby done to the obvious designs of the Author of Nature. We shall not hold it out of place, though we notice one or two of these instances, by which it might be seen that the mental philosophy, when studied in connexion with the palpable views of Him by whom all its principles and processes were ordained, is fitted to enlighten the practice of legislation, and more especially to determine the wisdom of certain arrangements which have for their object the economic well-being of society.

32. We feel the arduousness of our peculiar task, and the feeling is not at all alleviated by our sense of its surpassing dignity. The superiority of mind to matter has often been the theme of eloquence to moralists. For what were all the wonders of the latter and all its glories, without a spectator mind that could intelligently view and that could tastefully admire them? Let every eye be irrevocably closed, and this were equivalent to the entire annihilation in nature of the element of light; and in like manner, if the light of all consciousness were put out in the world of mind, the world of matter, though as rich in beauty, and in the means of benevolence as before, were thereby reduced to a virtual nonentity. In these circumstances, the lighting up again of even but one mind would restore its being, or at least its significancy to that system of materialism, which, untouched itself, had just been desolated of all those beings in whom it could kindle reflection, or to whom it could minister the sense of enjoyment. It were tantamount to the second creation of it,—or, in other words, one living intelligent spirit is of higher reckoning and mightier import than a dead universe.



PART I.

ON THE ADAPTATION OF EXTERNAL NATURE TO THE MORAL CONSTITUTION OF MAN.

CHAPTER I.

On the Supremacy of Conscience.

1. AN abstract question in morals is distinct from a question respecting the constitution of man's moral nature; and the former ought no more to be confounded with the latter, than the truths of geometry with the faculties of the reasoning mind which comprehends them. The virtuousness of justice was a stable doctrine in ethical science, anterior to the existence of the species; and would remain so, though the species were destroyed—just as much as the properties of a triangle are the enduring stabilities of mathematical science; and that, though no matter had been created to exemplify the positions or the figures of geometry. The objective nature of virtue is one thing. The subjective nature of the human mind, by which virtue is felt and recognised, is another. It is not from the former, any more than from the eternal truths of geometry, that we can demonstrate the existence or attributes of God—but from the latter, as belonging to the facts of a creation emanating from His will, and therefore bearing upon it the stamp of His character. The nature and constitution of virtue form a distinct subject of inquiry from the nature and constitution of the human mind. Virtue is not a creation of the Divine will, but has had everlasting residence in the nature of the Godhead. The mind of man is a creation; and therefore indicates, by its characteristics, the character of Him, to the fiat and the forthgoing of whose will it owes its existence. We must frequently, in the course of this discussion, advert to the principles of ethics; but it is not on the system of ethical doctrine that our argument properly is founded. It is on the phenomena and the laws of actual human nature, which itself, one of the great facts of creation, may be regarded like all its facts, as

bearing on it the impress of that mind which gave birth to creation.

2. But further. It is not only not with the system of ethical doctrine—it is not even with the full system of the philosophy of our nature that we have properly to do. On this last there is still a number of unsettled questions; but our peculiar argument does not need to wait for the conclusive determination of them. For example, there is many a controversy among philosophers respecting the primary and secondary laws of the human constitution. Now, if it be an obviously beneficial law, it carries evidence for a God, in the mere existence and operation of it, independently of the rank which it holds, or of the relation in which it stands to the other principles of our internal mechanism. It is thus that there may, at one and the same time, be grounded on the law in question a clear geological inference; and yet there may be associated with it an obscure philosophical speculation. It is well that we separate these two; and, more especially, that the decisive attestation given by any part or phenomenon of our nature to the Divine goodness, shall not be involved in the mist and metaphysical perplexity of other reasonings, the object of which is altogether distinct and separate from our own. The facts of the human constitution, apart altogether from the philosophy of their causation, demonstrate the wisdom and benevolence of Him who framed it: and while it is our part to follow the light of this philosophy, as far as the light and the guidance of it are sure, we are not, in those cases, when the final cause is obvious as day, though the proximate efficient cause should be hidden in deepest mystery,—we are not, on this account, to confound darkness with light, or light with darkness.

3. By attending throughout to this observation, we shall be saved from a thousand irrelevancies as well as obscurities of argument; and it is an observation peculiarly applicable, in announcing that great fact or phenomenon of mind, which, for many reasons, should hold a foremost place in our demonstration—we mean the felt supremacy of conscience. Philosophers there are, who have attempted to resolve this fact into ulterior or ultimate ones in the mental constitution; and who have denied to the faculty a place among its original and uncompounded principles. Sir James Mackintosh tells us of the generation of human conscience; and, not merely states, but endeavours to explain the phenomenon of its felt supremacy within us. Dr. Adam Smith also assigns a pedigree to our moral judgments; but, with all his peculiar notions respecting the origin of the awards of conscience, he never once disputes their authority; or, that, by the general consent of mankind, this authority is, in sentiment and opinion at least, conceded to them.* It is some-

* "Upon whatever," observes Dr. Adam Smith, "we suppose our moral faculties to be founded, whether upon a certain modification of reason, upon an original

what like an antiquarian controversy respecting the first formation and subsequent historical changes of some certain court of government, the rightful authority of whose decisions and acts is, at the same time, fully recognised. And so, philosophers have disputed regarding the court of conscience—of what materials it is constructed, and by what line of genealogy from the anterior principles of our nature it has sprung. Yet most of these have admitted the proper right of sovereignty which belongs to it; its legitimate place as the master and the arbiter over all the appetites and desires and practical forces of human nature. Or, if any have dared the singularity of denying this, they do so in opposition to the general sense and general language of mankind, whose very modes of speech compel them to affirm that the biddings of conscience are of paramount authority—its peculiar office being to tell what all men should, or all men ought to do.

4. The proposition, however, which we are now urging, is not that the obligations of virtue are binding, but that man has a conscience which tells him that they are so—not that justice and truth and humanity are the dogmata of the abstract moral system, but that they are the dictates of man's moral nature—not that in themselves they are the constituent parts of moral rectitude, but that there is a voice within every heart which thus pronounces on them. It is with the constitution of morality, viewed objectively, as a system or theory of doctrine, that we have properly to do; but with the constitution of man's spirit, viewed as the subject of certain phenomena and laws—and, more particularly, with a great psychological fact in human nature, namely, the homage rendered by it to the supremacy of conscience. In a word, it is not of a category, but of a creation that we are speaking. The one can tell us nothing of the divine character, while the other might afford most distinct and decisive indications of it. We could find no demonstration whatever of the divine purposes, on a mere ethical, any more than we could, on a logical or mathematical category. But it is very different with an actual creation, whether in mind or in matter—a mechanism of obvious contrivance and whose workings and tendencies, therefore, must be referred to the design, and so to the disposition or character of that Being, whose spirit hath devised and whose fingers have framed it.

5. And neither do we urge the proposition that conscience has

instinct called a moral sense, or upon some other principle of our nature, it cannot be doubted that they were given us for the direction of our conduct in this life. They carry along with them the most evident badges of this authority, which denote that they were set up within us to be the supreme arbiters of all our actions, to superintend all our senses, passions and appetites, and to judge how far each of them was either to be indulged or restrained. It is the peculiar office of these faculties to judge, to bestow censure or applause upon all the other principles of our nature."—*Theory of Moral Sentiments*, Part iii. chap. v.

in every instance, the actual direction of human affairs, for this were in the face of all experience. It is not that every man obeys her dictates, but that every man feels he ought to obey them. These dictates are often in life and practice disregarded: so that conscience is not the sovereign *de facto*. Still there is a voice within the hearts of all which asserts that conscience is the sovereign *de jure*; that to her belongs the command rightfully, even though she do not possess it actually. In a season of national anarchy, the actual power and the legitimate authority are often disjoined from each other. The lawful monarch may be dethroned, and so lose the might; while he continues to possess—nay, while he may be acknowledged throughout his kingdom to possess the right of sovereignty. The distinction still is made, even under this reign of violence, between the usurper and the lawful sovereign; and there is a similar distinction among the powers and the principles of the human constitution, when an insurrection takes place of the inferior against the superior; and conscience, after being dethroned from her place of mastery and control, is still felt to be the superior, or rather supreme faculty of our nature notwithstanding. She may have fallen from her dominion, yet still wear the badges of a fallen sovereign, having the acknowledged right of authority, though the power of enforcement has been wrested away from her. She may be outraged in all her prerogatives by the lawless appetites of our nature,—but not without the accompanying sense within of an outrage and a wrong having been inflicted, and a reclaiming voice from thence which causes itself to be heard and which remonstrates against it. The insurgent and inferior principles of our constitution may, in the uproar of their wild mutiny, lift a louder and more effective voice than the small still voice of conscience. They have the might but not the right. Conscience, on the other hand, is felt to have the right though not the might—the legislative office being that which properly belongs to her, though the executive power should be wanting to enforce her enactments. It is not the reigning but the rightful authority of conscience, that we, under the name of her supremacy, contend for; or, rather the fact that, by the consent of all our higher principles and feelings, this rightful authority is reputed to be hers; and, by the general concurrence of mankind awarded to her.

6. And here it is of capital importance to distinguish between an original and proper tendency, and a subsequent aberration. This has been well illustrated by the regulator of a watch, whose office and primary design, and that obviously announced by the relation in which it stands to the other parts of the machinery, is to control the velocity of its movements. And we should still perceive this to have been its destination, even though, by accident or decay, it had lost the power of command which at the first belonged to it. We should not misunderstand the purpose of its maker, although, in virtue of

some deterioration or derangement which the machinery had undergone, that purpose were now frustrated. And we could discern the purpose in the very make and constitution of the mechanism. We might even see it to be an irregular watch; and yet this needs not prevent us from seeing, that, at its original fabrication, it was made for the purpose of moving regularly. The mere existence and position of the regulator might suffice to indicate this,—although it had become powerless, either from the wearing of the parts, or from some extrinsic disturbance to which the instrument had been exposed. The regulator, in this instance, may be said to have the right, though not the power of command, over the movements of the timepiece; yet the loss of the power has not obliterated the vestiges of the right; so that, by the inspection of the machinery alone, we both learn the injury which has been done to it, and the condition in which it originally came from the hand of its maker—a condition of actual as well as rightful supremacy, on the part of the regulator, over all its movements. And a similar discovery may be made, by examination of the various parts and principles which make up the moral system of man: for we see various parts and principles there. We see Ambition, having power for its object, and without the attainment of which it is not satisfied; and Avarice, having wealth for its object, without the attainment of which it is not satisfied; and Benevolence, having for its object the good of others, without the attainment of which it is not satisfied; and the love of Reputation, having for its object their applause, without which it is not satisfied; and lastly, to proceed no further in the enumeration, Conscience, which surveys and superintends the whole man, whose distinct and appropriate object it is to have the entire control both of his inward desires and outward doings, and without the attainment of this it is thwarted from its proper aim, and remains unsatisfied. Each appetite, or affection of our nature, has its own distinct object; but this last is the object of Conscience, which may be termed the moral affection. The place which it occupies, or rather which it is felt that it should occupy, and which naturally belongs to it, is that of a governor, claiming the superiority, and taking to itself the direction over all the other powers and passions of humanity. If this superiority be denied to it, there is a felt violence done to the whole economy of man. The sentiment is, that the thing is not as it should be: and even after conscience is forced, in virtue of some subsequent derangement, from this station of rightful ascendancy, we can still distinguish between what is the primitive design or tendency, and what is the posterior aberration. We can perceive, in the case of a deranged or distempered watch, that the mechanism is out of order; but even then, on the bare examination of its workmanship, and more especially from the place and bearing of its regulator, can we pronounce that it was made for moving regularly. And in like manner, on the bare inspection of our mental economy

alone, and more particularly from the place which conscience has there, can we, even in the case of the man who refuses to obey its dictates, affirm that he was made for walking conscientiously.

7. The distinction which we now labour to establish between conscience, and the other principles of our nature, does not respect the actual force or prevalence which may, or may not, severally belong to them. It respects the universal judgment which, by the very constitution of our nature, is passed on the question of rightness—on the question, which of all these should have the prevalence, whenever there happens to be a contest between them. All which we affirm is, that if conscience prevail over the other principles, then every man is led, by the very make and mechanism of his internal economy, to feel that this is as it ought to be; or, if these others prevail over conscience, that this is not as it ought to be. One, it is generally felt, may be too ambitious, or too much set on wealth and fame, or too resentful of injury, or even too facile in his benevolence, when carried to the length of being injudicious and hurtful; but no one is ever felt, if he have sound and enlightened views of morality, to be too conscientious. When we affirm this of conscience, we but concur in the homage rendered to it by all men, as being the rightful, if not the actual superior, among all the feelings and faculties of our nature. It is a truth, perhaps, too simple for being reasoned; but this is because, like many of the most important and undoubted certainties of human belief, it is a truth of instant recognition. When stating the supremacy of conscience, in the sense that we have explained it, we but state what all men feel; and our only argument, in proof of the assertion, is—our only argument can be, an appeal to the experience of all men.

8. Bishop Butler has often been spoken of as the first discoverer of this great principle in our nature; though, perhaps, no man can properly be said to discover what all men are conscious of. But certain it is, that he is the first who hath made it the subject of a full and reflex cognisance. It forms the argument of his three first sermons, in a volume which may safely be pronounced, the most precious repository of sound ethical principles extant in any language. The authority of conscience, says Dugald Stewart, “although beautifully described by many of the ancient moralists, was not sufficiently attended to by modern writers, as a fundamental principle in the science of ethics, till the time of Dr. Butler.” It belongs to the very essence of the principle, that we clearly distinguish, between what we find to be the actual force of conscience, and what we feel to be its rightful authority. These two may exist in a state of separation from each other just as in a Civil Government, the reigning power may, in seasons of anarchy, be dissevered from that supreme court or magistrate to whom it rightfully belongs. The mechanism of a political fabric is not adequately or fully described by the mere enumeration of its parts. There must also

enter into the description, the relation which the parts bear to each other; and more especially, the paramount relation of rightful ascendancy and direction, which that part, in which the functions of Government are vested, bears to the whole. Neither is the mechanism of man's personal constitution fully or adequately described, by merely telling us in succession the several parts of which it is composed—as the passions, and the appetites, and the affections, and the moral sense, and the intellectual capacities, which make up this complex and variously gifted creature. The particulars of his mental system must not only be stated, each in their individuality; but the bearing or connexion which each has with the rest—else it is not described as a system at all. In making out this description, we should not only not overlook the individual faculty of conscience, but we must not overlook its relative place among the other feelings and faculties of our nature. That place is the place of command. What conscience lays claim to is the mastery or regulation over the whole man. Each desire of our nature rests or terminates in its own appropriate object, as the love of fame in applause, or hunger in food, or revenge in the infliction of pain upon its object, or affection for another in the happiness and company of the beloved individual. But the object of the moral sense is to arbitrate and direct among all these propensities. It claims the station and the prerogative of a mistress over them, its peculiar office is that of superintendence, and there is a certain feeling of violence or disorder, when the mandates which it issues in this capacity, are not carried into effect. Every affection in our nature is appeased by the object that is suited to it. The object of conscience is the subordination of the whole to its dictates. Without this it remains unappeased, and as if bereft of its rights. It is not a single faculty, taking its own separate and unconnected place among the other feelings and faculties which belong to us. Its proper place is that of a guide or a governor. It is the ruling power in our nature; and its proper, its legitimate business, is to prescribe that man shall be as he ought, and do as he ought. But instead of expatiating any further at present in language of our own, let us here admit a few brief sentences from Butler himself, that great and invaluable expounder both of the human constitution, and of moral science. “That principle by which we survey, and either approve or disapprove our own heart, temper, and actions, is not only to be considered as what in its turn is to have some influence, which may be said of every passion, of the basest appetites: but likewise as being superior; as from its very nature manifestly claiming superiority over all others: insomuch that you cannot form a notion of this faculty conscience, without taking in judgment, direction and superintendency. This is a constituent part of the idea, that is of the faculty itself: and to preside and govern, from the very economy and constitution of man, belongs to it. Had it strength, as it has right; had it power, as it has

manifest authority ; it would absolutely govern the world." "This faculty was placed within us to be our proper governor ; to direct and regulate all under principles, passions, and motives of action. This is its right and office. Thus sacred is its authority. And how often soever men violate and rebelliously refuse to submit to it, for supposed interest which they cannot otherwise obtain, or for the sake of passion which they cannot otherwise gratify ; this makes no alteration as to the *natural right* and *office* of conscience.

9. Now it is in these phenomena of Conscience that Nature offers to us, far her strongest argument, for the moral character of God. Had he been an unrighteous Being himself, would He have given to this the obviously superior faculty in man, so distinct and authoritative a voice on the side of righteousness ? Would He have so constructed the creatures of our species, as to have planted in every breast a reclaiming witness against himself ? Would he have thus inscribed on the tablet of every heart the sentence of his own condemnation ; and is not this just as unlikely, as that He should have inscribed it in written characters on the forehead of each individual ? Would He so have fashioned the workmanship of His own hands ; or, if a God of cruelty, injustice, and falsehood, would He have placed in the station of master and judge that faculty which, felt to be the highest in our nature, would prompt a generous and high-minded revolt of all our sentiments against the Being who formed us ? From a God possessed of such characteristics, we should surely have expected a differently-moulded humanity ; or, in other words, from the actual constitution of man, from the testimonies on the side of all righteousness, given by the vicegerent within the heart, do we infer the righteousness of the Sovereign who placed it there. He would never have established a conscience in man, and invested it with the authority of a monitor, and given to it those legislative and judicial functions which it obviously possesses ; and then so framed it, that all its decisions should be on the side of that virtue which he himself disowned, and condemnatory of that vice which he himself exemplified. This is an evidence for the righteousness of God, which keeps its ground, amid all the disorders and aberrations to which humanity is liable ; and can no more, indeed, be deafened or overborne by these than is the rightful authority of public opinion, by the occasional outbreakings of iniquity and violence which take place in society. This public opinion may, in those seasons of misrule when might prevails over right, be deforced from the practical ascendancy which it ought to have ; but the very sentiment that it so ought, is our reason for believing the world to have been originally formed, in order that virtue might have the rule over it. In like manner, when, in the bosom of every individual man, we can discern a conscience, placed there with the obvious design of being a guide and a commander, it were difficult not to believe, that, whatever the partial outrages may be which the cause of virtue has

to sustain, it has the public mind of the universe in its favour; and that therefore He, who is the Maker and the Ruler of such a universe, is a God of righteousness. Amid all the subsequent obscurations and errors, the original design, both of a deranged watch and of a deranged human nature, is alike manifest; first, of the maker of the watch, that its motions should harmonize with time; second, of the maker of man, that his movements should harmonize with truth and righteousness. We can, in most cases, discern between an aberration and an original law; between a direct or primitive tendency and the effect of a disturbing force, by which that tendency is thwarted and overborne. And so of the constitution of man. It may be now a loosened and disproportioned thing, yet we can trace the original structure—even as from the fragments of a ruin, we can obtain the perfect model of a building from its capital to its base. It is thus that, however prostrate conscience may have fallen, we can still discern its place of native and original pre-eminence, as being at once the legislator and the judge in the moral system, though the executive forces of the system have made insurrection against it, and thrown the whole into anarchy. There is a depth of mystery in every thing connected with the existence or the origin of evil in creation; yet, even in the fiercest uproar of our stormy passions, Conscience, though in her softest whispers, gives to the supremacy of rectitude the voice of an undying testimony; and her light still shining in a dark place, her unquelled accents still heard in the loudest outcry of Nature's rebellious appetites, form the strongest argument within reach of the human faculties, that, in spite of all partial or temporary derangements, Supreme Power and Supreme Goodness are at one. It is true that rebellious man hath, with daring footstep, trampled on the lessons of Conscience; but why, in spite of man's perversity, is conscience, on the other hand, able to lift a voice so piercing and so powerful, by which to remonstrate against the wrong, and to reclaim the honours that are due to her? How comes it that, in the mutiny and uproar of the inferior faculties, that faculty in man, which wears the stamp and impress of the highest, should remain on the side of truth and holiness? Would humanity have thus been moulded by a false and evil spirit; or would he have committed such impolicy against himself, as to insert in each member of our species a principle which would make him feel the greatest complacency in his own rectitude, when he feels the most high-minded revolt of indignation and dislike against the Being who gave him birth? It is not so much that Conscience takes a part among the other faculties of our nature; but that Conscience takes among them the part of a governor, and that man, if he do not obey her suggestions, still, in despite of himself, acknowledges her rights. It is a mighty argument for the virtue of the governor above, that all the laws and injunctions of the governor below are on the side of virtue. It seems as if He had left this representative, or remaining

witness, for Himself, in a world that had cast off its allegiance; and that, from the voice of the judge within the breast, we may learn the will and the character of Him who hath invested with such authority his dictates. It is this which speaks as much more demonstratively for the presidency of a righteous God in human affairs, than for that of impure or unrighteous demons, as did the rod of Aaron, when it swallowed the rods of the enchanters and magicians in Egypt. In the wildest anarchy of man's insurgent appetites and sins, there is still a reclaiming voice—a voice which, even when in practice disregarded, it is impossible not to own; and to which, at the very moment that we refuse our obedience, we find that we cannot refuse the homage of what ourselves do feel and acknowledge to be the best, the highest principles of our nature.

10. However difficult from the very simplicity of the subject it may be, to state or to reason the argument for a God, which is founded on the supremacy of conscience—still, historically and experimentally, it will be found, that it is of more force than all other arguments put together, for originating and upholding the natural theism which there is in the world. The theology of conscience is not only of wider diffusion, but of far more practical influence than the theology of academic demonstration. The ratiocination by which this theology is established, is not the less firm or the less impressive, that, instead of a lengthened process, there is but one step between the premises and the conclusion—or, that the felt presence of a judge within the breast, powerfully and immediately suggests the notion of a Supreme Judge and Sovereign, who placcd it there. Upon this question, the mind does not stop short at mere abstraction; but, passing at once from the abstract to the concrete, from the law of the heart, it makes the rapid inference of a lawgiver. It is the very rapidity of this inference which makes it appear like intuition; and which has given birth to the mystic theology of innate ideas. Yet the theology of conscience disclaims such mysticism, built, as it is, on a foundation of sure and sound reasoning; for the strength of an argumentation in no wise depends upon the length of it. The sense of a governing principle within, begets in all men the sentiment of a living governor without and above them, and it does so with all the speed of an instantaneous feeling; yet it is not an impression, it is an inference notwithstanding—and as much so as any inference from that which is seen, to that which is unseen. There is, in the first instance, cognisance taken of a fact—if not by the outward eye, yet as good, by the eye of consciousness which has been termed the faculty of internal observation. And the consequent belief of a God, instead of being an instinctive sense of the Divinity, is the fruit of an inference grounded on that fact. There is instant transition made, from the sense of a Monitor within to the faith of a living Sovereign above; and this argument, described by all, but with such speed as almost to warrant the expression of its

being felt by all, may be regarded, notwithstanding the force and fertility of other considerations, as the great prop of natural religion among men.

11. And we mistake, if we think it was ever otherwise, even in the ages of darkest and most licentious paganism. This theology of conscience has often been greatly obscured, but never, in any country or at any period in the history of the world, has it been wholly obliterated. We behold the vestiges of it in the simple theology of the desert; and, perhaps, more distinctly there, than in the complex superstitions of an artificial and civilized heathenism. In confirmation of this, we might quote the invocations to the Great Spirit from the wilds of North America. But, indeed, in every quarter of the globe, where missionaries have held converse with savages, even with the rudest of nature's children—when speaking on the topics of sin and judgment, they did not speak to them in vocables unknown. And as this sense of a universal law and a Supreme Lawgiver never waned into total extinction among the tribes of ferocious and untamed wanderers—so neither was it altogether stifled by the refined and intricate polytheism of more enlightened nations. The whole of classic authorship teems with allusions to a Supreme Governor and Judge: And when the guilty Emperors of Rome were tempest-driven by remorse and fear, it was not that they trembled before a spectre of their own imagination. When terror mixed, which it often did, with the rage and cruelty of Nero, it was the theology of conscience which haunted him. It was not the suggestion of a capricious fancy which gave him the disturbance—but a voice issuing from the deep recesses of a moral nature, as stable and uniform throughout the species as is the material structure of humanity; and in the lineaments of which we may read that there is a moral regimen among men, and therefore a moral Governor who hath instituted, and who presides over it. Therefore it was that these imperial despots, the worst and haughtiest of recorded monarchs, stood aghast at the spectacle of their own worthlessness. It is true, there is a wretchedness which naturally and essentially belongs to a state of great moral unhingement; and this may account for their discomfords, but it will not account for their fears. They may, because of this, have felt the torments of a present misery. But whence their fears of a coming vengeance? They would not have trembled at nature's law, apart from the thought of nature's lawgiver. The imagination of an unsanctioned law would no more have given disquietude, than the imagination of a vacant throne. But the law, to their guilty apprehensions, bespoke a judge. The throne of heaven, to their troubled eye, was filled by a living monarch. Righteousness, it was felt, would not have been so enthroned in the moral system of man, had it not been previously enthroned in the system of the universe; nor would it have held such a place and pre-eminence in the judgment of all spirits, had not the

father of spirits been its friend and ultimate avenger. This is not a local or geographical notion. It is a universal feeling—to be found wherever men are to be found, because interwoven with the constitution of humanity. It is not, therefore, the peculiarity of one creed, or of one country. It circulates at large throughout the family of man. We can trace it in the theology of savage life; nor is it wholly overborne by the artificial theology of a more complex and idolatrous paganism. Neither crime nor civilization can extinguish it; and, whether in the “*conscientia scelerum*” of the fierce and frenzied Cataline, or in the tranquil contemplative musings of Socrates and Cicero, we find the impression of at once a righteous and a reigning Sovereign.

12. And it confirms still more our idea of a government—that conscience not only gives forth her mandates with the tone and authority of a Superior; but, as if on purpose to enforce their observance, thus follows them up with an obvious discipline of rewards and punishments. It is enough but to mention, on the one hand, that felt complacency which is distilled, like some precious elixir, upon the heart by the recollection of virtuous deeds and virtuous sacrifices; and, on the other hand, those inflictions of remorse, which are attendant upon wickedness, and wherewith, as if by the whip of a secret tormentor, the heart of every conscious sinner is agonized. We discern in these the natural sanctions of morality, and the moral character of Him who hath ordained them. We cannot otherwise explain the peace and triumphant satisfaction which spring from the consciousness of well doing—nor can we otherwise explain the degradation as well as bitter distress, which a sense of demerit brings along with it. Our only adequate interpretation of these phenomena is, that they are the present remunerations or the present chastisements of a God who loveth righteousness, and who hateth iniquity. Nor do we view them as the conclusive results of virtue and vice, but rather as the tokens and the precursors either of a brighter reward or of a heavier vengeance, that are coming. It is thus that the delight of self-approbation, instead of standing alone, brings hope in its train; and remorse, instead of standing alone, brings terror in its train. The expectations of the future are blended with these joys and sufferings of the present; and all serve still more to stamp an impression, of which traces are to be found in every quarter of the earth—that we live under a retributive economy, and that the God who reigns over it takes a moral and judicial cognisance of the creatures whom He hath formed.

13. What then are the specific injunctions of conscience? for on this question essentially depends every argument that we can derive from this power or property of our nature, for the moral character of God. If, on the one hand, the lessons given forth by a faculty, which so manifestly claims to be the pre-eminent and ruling faculty of our nature, be those of deceit and licentiousness and cruelty—

then, from the character of such a law, should we infer the character of the lawgiver; and so feel the conclusion to be inevitable, that we are under the government of a malignant and unrighteous God, at once the patron of vice and the persecutor of virtue in the world. If on the other hand, temperance, and chastity, and kindness, and integrity, and truth, be the mandates which generally, if not invariably proceed from her—then, on the same principles of judgment, should we reckon that He who is the author of conscience, and who gave it the place of supremacy and honour, which it so obviously possesses in the moral system of man, was himself the friend and the exemplar of all those virtues which enter into the composition of perfect moral rectitude. In the laws and the lessons of human conscience, would we study the character of the Godhead, just as we should study the views and dispositions of a monarch, in the instructions given by him to the viceroy of one of his provinces. If, on the one hand, virtue be prescribed by the authority of conscience, and followed up by her approval, in which very approval there is felt an inward satisfaction and serenity of spirit, that of itself forms a most delicious reward; and if, on the other hand, the perpetrations of wickedness are followed up by the voice of her rebuke, in which, identical with remorse, there is a sting of agony and discomfort, amounting to the severest penalty—then, are we as naturally disposed to infer of Him who ordained such a mental constitution that He is the righteous Governor of men, as, if seated on a visible throne in the midst of us, He had made the audible proclamation of His law, and by His own immediate hand, had distributed of His gifts to the obedient, and inflicted chastisements on the rebellious. The law of conscience may be regarded as comprising all those virtues which the hand of the Deity hath inscribed on the tablet of the human heart, or on the tablet of natural jurisprudence; and an argument for these being the very virtues which characterise and adorn Himself, is that they must have been transcribed from the prior tablet of His own nature.

14. We are sensible that there is much to obscure this inference in the actual circumstances of the world. More especially—it has been alleged, on the side of scepticism, that there is an exceeding diversity of moral judgments among men; that, out of the multifarious decisions of the human conscience, no consistent code of virtue can be framed; and that, therefore, no consistent character can be ascribed to Him, who planted this faculty in the bosom of our species, and bade it speak so uncertainly and so variously.* But to

* On the uniformity of our moral judgments, we would refer to the 74th and 75th of Dr. Brown's Lectures on the Philosophy of the Human Mind. "If we bear in mind," says Sir James Mackintosh, "that the question relates to the coincidence of all men in considering the same qualities as virtues, and not to the preference of one class of virtues by some, and of a different class by others, the exceptions from the agreement of mankind, in their systems of practical morality, will be reduced to absolute insignificance; and we shall learn to view them as no more affecting the

this it may be answered, in the first place, that the apparent diversity is partly reducible into the blinding, or, at least, the distorting effect of passion and interest, which sometimes are powerful enough to obscure our perception, even of mathematical and historical truths, as well as of moral distinctions; and without therefore affecting the stability of either. It is thus, for example, that mercantile cupidity has blinded many a reckless adventurer to the enormous injustice of the slave trade; that passion and interest together have transmuted revenge into a virtue; and that the robbery, which, if prosecuted only for the sake of individual gain, would have appeared to all under an aspect of most revolting selfishness, puts on the guise of patriotism, when a whole nation deliberates on the schemes, or is led by a career of daring and lofty heroism, to the spoliations of conquest. In all such cases, it is of capital importance to distinguish between the real character of any criminal action, when looked to calmly, comprehensively, and fully; and what that is in the action which the perpetrator singles out and fastens upon as his plea, when he is either defending it to others, or reconciling it to his own conscience. In as far as he knows the deed to be incapable of vindication, and yet rushes on the performance of it, there is but delinquency of conduct incurred, not a diversity of moral judgment; nor does Conscience, in this case, at all betray any caprice or uncertainty in her decisions. It is but the conduct, and not the conscience which is in fault; and to determine whether the latter is in aught chargeable with fluctuation, we must look not to the man's performance, but to his plea. Two men may differ as to the moral character of an action; but if each is resting the support of his own view on a different principle from the other, there may still be a perfect uniformity of moral sentiment between them. They own the authority of the same laws; they only disagree in the application of them. In the first place, the most vehement denouncer of a guilty commerce is at one with the most strenuous of its advocates, on the duty which each man owes to his family; and again, neither of them would venture to maintain the lawfulness of the trade, because of the miseries inflicted by it on those wretched sufferers who were its victims. The defender of this ruthless and rapacious system disowns not, in sentiment at least, however much he may disown in practice, the obligations of justice and humanity—nay, in all the palliations which he attempts of the enormity in question, he speaks of these as undoubted virtues, and renders the homage of his moral acknowledgments to them all. In the sophistry of his vindication, the principles of the ethical system are left untouched and entire. He meddles not with the virtuousness either of humanity or justice; but he tells of the humanity of slavery, and the

harmony of the moral faculties, than the resemblance of the limbs and features is affected by monstrous conformations, or by the unfortunate effects of accident and disease in a very few individuals."

justice of slavery. It is true, that he heeds not the representations which are given of the atrocities of his trade—that he does not attend because he wills not to attend; and in this there is practical unfairness. Still it but resolves itself into perversity of conduct, and not into perversity of sentiment. The very dread and dislike he has for the informations of the subject, are symptoms of a feeling that his conscience cannot be trusted with the question; or, in other words, prove him to be possessed of a conscience which is just like that of other men. The partialities of interest and feeling may give rise to an infinite diversity of moral judgments in our estimate of actions; while there may be the most perfect uniformity and stability of judgment in our estimate of principles: and, on all the great generalities of the ethical code, Conscience may speak the same language, and own one and the same moral directory all the world over.

15. When consciences then pronounce differently of the same action, it is for the most part, or rather, it is almost always, because understandings view it differently. It is either because the controversialists are regarding it with unequal degrees of knowledge; or, each, through the medium of his own partialities. The consciences of all would come forth with the same moral decision, were all equally enlightened in the circumstances, or in the essential relations and consequences of the deed in question; and, what is just as essential to this uniformity of judgment, were all viewing it fairly as well as fully. It matters not, whether it be ignorantly or wilfully, that each is looking at this deed, but in the one aspect, or in the one relation that is favourable to his own peculiar sentiment. In either case, the diversity of judgment on the moral qualities of the same action, is just as little to be wondered at as a similar diversity on the material qualities of the same object—should any of the spectators labour under an involuntary defect of vision, or voluntarily persist either in shutting or in averting his eyes. It is thus that a quarrel has well been termed a misunderstanding, in which each of the combatants may consider, and often honestly consider, himself to be in the right; and that, on reading the hostile memorials of two parties in a litigation, we can perceive no difference in their moral principles, but only in their historical statements; and that, in the public manifestoes of nations when entering upon war, we can discover no trace of a contrariety of conflict in their ethical systems, but only in their differently put or differently coloured representations of fact; all proving, that, with the utmost diversity of judgment among men respecting the moral qualities of the same thing, there may be a perfect identity of structure in their moral organs notwithstanding; and that Conscience, true to her office, needs but to be rightly informed, that she may speak the same language, and give forth the same lessons in all the countries of the earth.

16. It is this which explains the moral peculiarities of different

nations. It is not that justice, humanity, and gratitude are not the canonized virtues of every region; or that falsehood, cruelty, and fraud would not, in their abstract and unassociated nakedness, be viewed as the objects of moral antipathy and rebuke. It is, that, in one and the same material action, when looked to in all the lights of which, whether in reality or by the power of imagination, it is susceptible, various, nay, opposite moral characteristics may be blended; and that while one people look to the good only without the evil, another may look to the evil only without the good. And thus the identical acts which in one nation are the subjects of a most reverent and religious observance, may, in another, be regarded with a shuddering sense of abomination and horror. And this, not because of any difference in what may be termed the moral categories of the two people, nor because, if moral principles in their unmixed generality were offered to the contemplation of either, either would call evil good or good evil. When theft was publicly honoured and rewarded in Sparta, it was not because theft in itself was reckoned a good thing; but because patriotism, and dexterity, and those services by which the interests of patriotism might be supported, were reckoned to be good things. When the natives of Hindostan assemble with delight around the agonies of a human sacrifice, it is not because they hold it good to rejoice in a spectacle of pain; but because they hold it good to rejoice in a spectacle of heroic devotion to the memory of the dead. When parents are exposed, or children are destroyed, it is not because it is deemed to be right that there should be the infliction of misery for its own sake; but because it is deemed to be right that the wretchedness of old age should be curtailed, or that the world should be saved from the miseries of an over-crowded species. In a word, in the very worst of these anomalies, some form of good may be detected, which has led to their establishment; and still, some universal and undoubted principle of morality, however perverted or misapplied, can be alleged in vindication of them. A people may be deluded by their ignorance; or misguided by their superstition; or, not only hurried into wrong deeds, but even fostered into wrong sentiments, under the influences of that cupidity or revenge, which are so perpetually operating in the warfare of savage or demi-savage nations. Yet, in spite of all the topical moralities to which these have given birth, there is an unquestioned and universal morality notwithstanding. And in every case, where the moral sense is unfettered by these associations; and the judgment is uncramped, either by the partialities of interest or by the inveteracy of national customs which habit and antiquity have rendered sacred—Conscience is found to speak the same language, nor, to the remotest ends of the world, is there a country or an island, where the same uniform and consistent voice is not heard from her. Let the mists of ignorance and passion and artificial education be only cleared away; and the moral attributes of goodness and righteousness and truth be seen undistorted, and in

their own proper guise; and there is not a heart or a conscience throughout earth's teeming population, which could refuse to do them homage. And it is precisely because the Father of the human family has given such hearts and conscience, to all his children, that we infer these to be the very sanctities of the Godhead, the very attributes of his own primeval nature.

17. There is a countless diversity of tastes in the world, because of the infinitely various circumstances and associations of men. Yet there is a stable and correct standard of taste notwithstanding, to which all minds that have the benefit of culture and enlargement, are gradually assimilating and approximating. It holds far more emphatically true, that in spite of the diversity of moral judgments, which are vastly less wide and numerous than the former, there is a fixed standard of morals, rallying around itself all consciences, to the greater principles of which, a full and unanimous homage is rendered from every quarter of the globe; and even to the lesser principles and modifications of which, there is a growing and gathering consent, with every onward step in the progress of light and civilization. In proportion as the understandings of men become more enlightened, do their consciences become more accordant with each other. Even now there is not a single people on the face of the earth, among whom barbarity and licentiousness and fraud are deified as virtues,—where it does not require the utmost strength, whether of superstition or of patriotism in its most selfish and contracted form, to uphold the delusion. Apart from these local and, we venture to hope, these temporary exceptions, the same moralities are recognised and honoured; and, however prevalent in practice, in sentiment at least, the same vices are disowned and execrated all the world over. In proportion as superstition is dissipated, and prejudice is gradually weakened by the larger intercourse of nations, these moral peculiarities do evidently wear away; till at length, if we may judge from the obvious tendency of things, conscience will, in the full manhood of our species, assert the universality and the unchangeableness of her decisions. There is no speech nor language, where her voice is not heard; her line is gone out through all the earth; and her words to the ends of the world.

18. On the whole, then, conscience, whether it be an original or a derived faculty, yet as founded on human nature, if not forming a constituent part of it, may be regarded as a faithful witness for God the author of that nature, and as rendering to his character a consistent testimony. It is not necessary, for the establishment of our particular lesson, that we should turn that which is clear into that which is controversial by our entering into the scientific question respecting the physical origin of conscience, or tracing the imagined pedigree of its descent from simple or anterior principles in the constitution of man. For, as has been well remarked by Sir James Mackintosh—"If conscience be inherent, that circumstance is, ac-

ording to the common mode of thinking, a sufficient proof of its title to veneration. But if provision be made, in the constitution and circumstances of all men for uniformity, producing it by processes similar to those which produce other acquired sentiments, may not our reverence be augmented by admiration of that supreme wisdom, which, in such mental contrivances, yet more highly than in the lower world of matter, accomplish mighty purposes by instruments so simple?" It is not therefore the physical origin, but the fact, of the uniformity of conscience, wherewith is concerned the theological inference that we attempt to draw from it. This ascendant faculty of our nature, which has been so often termed the divinity within us, notwithstanding the occasional sophistry of the passions, is on the whole, representative of the Divinity above us; and the righteousness and goodness and truth, the lessons of which it gives forth everywhere, may well be regarded, both as the laws which enter into the juridical constitution, and as the attributes which enter into the moral character of God.

19. We admit a considerable diversity of moral observation in the various countries of the earth, but without admitting any correspondent diversity of moral sentiment between them. When human sacrifices are enforced and applauded in one nation—this is not because of their cruelty, but notwithstanding of their cruelty. Even there, the universal principle of humanity would be acknowledged, that it were wrong to inflict a wanton and uncalled for agony on any of our fellows—but there is a local superstition which counteracts the universal principle, and overbears it. When in the republic of Sparta, theft, instead of being execrated as a crime, was dignified into an art and an accomplishment, and on that footing admitted into the system of their youthful education—it was not because of its infringement on the rights of property, but notwithstanding of that infringement, and only because a local patriotism made head against the universal principle, and prevailed over it. Apart from such disturbing forces as these, it will be found that the sentiments of men gravitate towards one and the same standard all over the globe; and that, when once the obscurations of superstition and selfishness are dissipated, there will be found the same moral light in every mind, a recognition of the same moral law, as the immutable and eternal code of righteousness for all countries and all ages. The following is the noble testimony of a heathen, who tells us with equal eloquence and truth, that, even amid all the perversities of a vitiated and endlessly diversified creed, conscience sat mistress over the whole earth, and asserted the supremacy of her own unalterable obligations. "Est quidem vera lex, recta ratio, naturæ congruens, diffusa in omnes, constans, sempiterna, quæ vocet ad officium jubendo, vetando a fraude deterreat; quæ tamen neque probis frustra jubet aut vetat, nec improbos jubendo aut vetando movet. Huic legi nec obrogari fas est, neque derogari ex hac aliquid licet, neque

tota abrogari potest. Nec vero, aut per senatum aut per populum solvi hac lege possumus. Neque est quærendus explanator aut interpres ejus alius. Nec erit alia lex Romæ, alia Athenis, alia nunc, alia posthac; sed et omnes gentes, et omni tempore, una lex et sempiterna et immortalis continebit; unusque erit communis quasi magister, et imperator omnium Deus ille, legis hujus inventor, disceptator, lator; cui qui non parebit, ipse se fugiet, ac naturum hominus aspernabitur, atque hoc ipso luct maximas pœnas, etiam si cætera supplicia quæ putantur effugerit."

20. Such then is our first argument for the moral character of God—even the moral character of the law of conscience; that conscience which He hath inserted among the faculties of our nature; and armed with the felt authority of a master; and furnished with sanctions for the enforcement of its dictates; and so framed, that, apart from the local perversities of the understanding or the habits, all its decisions are on the side of righteousness. The inference is neither a distant nor an obscure one, from the character of such a law to the character of its law-giver. Neither is it an inference, destroyed by the insurrection which has taken place on the part of our lower faculties, or by the actual prevalence of vice in the world. For this has only enabled conscience to come forth with another and additional demonstration of its sovereignty—just as the punishment of crime in society bears evidence to the justice of the government which is established there. In general, the inward complacency felt by the virtuous, does not so impressively bespeak the real purpose and character of this the ruling faculty in man, as do the remorse, and the terror, and the bitter dissatisfaction, wherewith the hearts of the wicked are exercised. It is true, that, by every act of iniquity, outrage is done to the law of conscience; but there is a felt reaction within which tells that the outrage is resented; and then it is, that conscience makes most emphatic assertion of its high prerogative, when, instead of coming forth as the benign and generous dispenser of its rewards to the obedient, it comes forth like an offended monarch in the character of an avenger. Were we endowed with prophetic vision, so as to behold, among the yet undisclosed secrets of futurity, the spectacle of a judge, and a judgment-seat, and an assembled world, and the retributions of pleasure and pain to the good and to the evil; this were fetching from afar an argument for the righteousness of God. But the instant pleasure and the instant pain wherewith conscience follows up the doings of man, brings this very argument within the limits of actual observation. Only, instead of being manifested by the light of a preternatural revelation, it is suggested to us by one of the most familiar certainties of experience, for in these phenomena and feelings of our own moral nature, do we behold not only a present judgment, but a present execution of the sentence.

CHAPTER II.

SECOND GENERAL ARGUMENT.

On the inherent Pleasure of the Virtuous, and Misery of the Vicious Affections.

1. WE are often told by moralists, that there is a native and essential happiness in moral worth; and a like native and essential wretchedness in moral depravity—insomuch that the one may be regarded as its own reward, and the other as its own punishment. We do not always recollect that this happiness on the one hand, and this misery on the other, are each of them made up, severally of distinct ingredients; and that thus, by mental analysis, we might strengthen our argument both for the being and the character of God. When we discover, that, into this alleged happiness of the good there enter more enjoyments than one, we, thereby obtain two or more testimonies of the divine regard for virtue; and the proof is enhanced in the same peculiar way, that the evidence of design is, in any other department of creation, when we perceive the concurrence of so many separate and independent elements, which meet together for the production of some complex and beneficial result.*

2. We have already spoken of one such ingredient. There is a felt satisfaction in the thought of having done what we know to be right; and, in counterpart to this complacency of self-approbation, there is a felt discomfort, amounting often to bitter and remorseful agony, in the thought of having done what conscience tells us to be wrong. This implies a sense of the rectitude of what is virtuous. But without thinking of its rectitude at all, without viewing it in reference either to the law of conscience or to the law of God, with no regard to jurisprudence in the matter—there is, in the virtuous affection itself, another and a distinct enjoyment. We ought to cherish and to exercise benevolence; and there is a pleasure in the consciousness of doing what we ought: but beside this moral sentiment, and beside the peculiar pleasure appended to benevolence as moral, there is a sensation in the merely physical affection of benevolence; and that sensation of itself, is in the highest degree pleasurable. The primary or instant gratification which there is in the direct and immediate feeling of benevolence is one thing: the secondary or reflex gratification which there is in the consciousness of benevolence as moral is another thing. The two are distinct of themselves; but the contingent union of them, in the case of every virtuous affection, gives a multiple force to the conclusion, that God is the lover, and, because so, the patron or the rewarder of virtue. He hath so constituted our nature, that in the very flow and exer-

* See Chap. I. 6.

cise of the good affections, there shall be the oil of gladness. There is instant delight in the first conception of benevolence. There is sustained delight in its continued exercise. There is consummated delight in the happy smiling and prosperous result of it. Kindness, and honesty, and truth, are, of themselves, and irrespective of their rightness, sweet unto the taste of the inner man. Malice, envy, falsehood, injustice, irrespective of their wrongness, have of themselves, the bitterness of gall and wormwood. The Deity hath annexed a high mental enjoyment, not to the consciousness only of good affections, but to the very sense and feeling of good affections. However closely these may follow on each other—nay, however implicated or blended together they may be at the same moment into one compound state of feeling; they are not the less distinct on that account, of themselves. They form two pleasurable sensations, instead of one; and their apposition, in the case of every virtuous deed or virtuous desire, exhibits to us that very concurrence in the world of mind, which obtains with such frequency and fulness in the world of matter—affording, in every new part that is added, not a simply repeated only, but a vastly multiplied evidence for design, throughout all its combinations. There is a pleasure in the very sensation of virtue; and there is a pleasure attendant on the sense of its rectitude. These two phenomena are independent of each other. Let there be a certain number of chances against the first in a random economy of things, and also a certain number of chances against the second. In the actual economy of things, where there is the conjunction of both phenomena—it is the product of those two numbers which represents the amount of evidence afforded by them, for a moral government in the world, and a moral Governor over them.

3. In the calm satisfactions of virtue, this distinction may not be so palpable, as in the pungent and more vividly felt inquietudes which are attendant on the wrong affections of our nature. The perpetual corrosion of that heart, for example, which frets in unhappy peevishness all the day long, is plainly distinct from the bitterness of that remorse which is felt, in the recollection of its harsh and injurious outbreakings on the innocent sufferers within its reach. It is saying much for the moral character of God, that he has placed a conscience within us, which administers painful rebuke on every indulgence of a wrong affection. But it is saying still more for such being the character of our Maker—so to have framed our mental constitution, that in the very working of these bad affections there should be the painfulness of a felt discomfort and discordancy. Such is the make or mechanism of our nature, that it is thwarted and put out of sorts, by rage and envy, and hatred; and this, irrespective of the adverse moral judgments which conscience passes upon them. Of themselves, they are unsavory; and no sooner do they enter the heart, than they shed upon it an immediate distillation of bitterness.

Just as the placid smile of benevolence bespeaks the felt comfort of benevolence; so, in the frown and tempest of an angry countenance, do we read the unhappiness of that man who is vexed and agitated by his own malignant affections—eating inwardly as they do on the vitals of his enjoyment. It is, therefore, that he is often styled, and truly, a self-tormentor; or, his own worst enemy. The delight of virtue in itself, is a separate thing from the delight of the conscience which approves it. And the pain of moral evil in itself, is a separate thing from the pain inflicted by conscience in the act of condemning it. They offer to our notice two distinct ingredients, both of the present reward attendant upon virtue, and of the present penalty attendant upon vice; and so, enhance the evidence that is before our eyes, for the moral character of that administration, under which the world has been placed by its author. The appetite of hunger is rightly alleged, in evidence of the care, wherewith the Deity hath provided for the well-being of our natural constitution; and the pleasurable taste of food is rightly alleged as an additional proof of the same. And so, if the urgent voice of conscience within, calling us to virtue, be alleged in evidence of the care, wherewith the Deity hath provided for the well-being of our moral constitution; the pleasurable taste of virtue in itself, with the bitterness of its opposite, may well be alleged as additional evidence thereof. They alike afford the present and the sensible tokens of a righteous administration, and so of a righteous God.

4. Our present argument is grounded, neither on the rectitude of virtue, nor on its utility in the grosser and more palpable sense of that term—but on the immediate sweetness of it. It is the office of conscience to tell us of its rectitude. It is by experience that we learn its utility. But the sweetness of it—the *dulce* of virtue, as distinguished from its *utile*, is a thing of instant sensation. It may be decomposed into two ingredients, with one of which conscience has to do—even the pleasure we have, when any deed or any affection of ours receives from her a favourable verdict. But it has another ingredient which forms the proper and the distinct argument that we are now urging—even the pleasure we have in the mere relish of the affection itself. If it be a proof of benevolence in God, that our external organs of taste should have been so framed, as to have a liking for wholesome food; it is no less the proof both of a benevolent and a righteous God, so to have framed our mental economy, as that right and wholesome morality should be palatable to the taste of the inner man. Virtue is not only seen to be bright—it is felt to be delicious. There is happiness in the very wish to make others happy. There is a heart's ease, or a heart's enjoyment, even in the first purposes of kindness, as well as in its subsequent performances. There is a certain rejoicing sense of clearness in the consistency, the exactitude of justice and truth. There is a triumphant elevation of spirit in magnanimity and honour. In per-

fect harmony with this, there is a placid feeling of serenity and blissful contentment in gentleness and humility. There is a noble satisfaction in those victories, which, at the bidding of principle, or by the power of self-command, may have been achieved over the propensities of animal nature. There is an elate independence of soul, in the consciousness of having nothing to hide, and nothing to be ashamed of. In a word, by the constitution of our nature, each virtue has its appropriate charm; and virtue, on the whole, is a fund of varied, as well as of perpetual enjoyment, to him who hath imbibed its spirit, and is under the guidance of its principles. He feels all to be health and harmony within; and without he seems as if to breathe in an atmosphere of beauteous transparency—proving how much the nature of man and the nature of virtue are in unison with each other. It is hunger which urges to the use of food; but it strikingly demonstrates the care and benevolence of God, so to have framed the organ of taste, as that there shall be a superadded enjoyment in the use of it. It is conscience which urges to the practice of virtue; but it serves to enhance the proof of a moral purpose, and therefore of a moral character in God, so to have framed our mental economy, that, in addition to the felt obligation of its rightness, virtue should of itself, be so regaling to the taste of the inner man.

5. In counterpart to these sweets and satisfactions of virtue, is the essential and inherent bitterness of all that is morally evil. We repeat, that, with this particular argument, we do not mix up the agonies of remorse. It is the wretchedness of vice in itself, not the wretchedness which we suffer because of its recollected and felt wrongness that we now speak of. It is not the painfulness of the compunction felt because of our anger, upon which we at this moment insist; but the painfulness of the emotion itself; and the same remark applies to all the malignant desires of the human heart. True, it is inseparable from the very nature of a desire, that there must be some enjoyment or other, at the time of its gratification; but, in the case of these evil affections, it is not unmixed enjoyment. The most ordinary observer of his own feelings, however incapable of analysis, must be sensible, even at the moment of wreaking, in full indulgence of his resentment, on the man who has provoked or injured him, that all is not perfect and entire enjoyment within; but that, in this, and indeed in every other malignant feeling, there is a sore burden of disquietude—an unhappiness tumultuating in the heart, and visibly pictured on the countenance. The ferocious tyrant who has only to issue forth his mandate, and strike dead at pleasure the victim of his wrath, with any circumstance too of barbaric caprice and cruelty, which his fancy in the very waywardness of passion unrestrained and power unbounded might suggest to him—he may be said to have experienced through life a thousand gratifications, in the solaced rage and revenge, which, though ever breaking forth on

some new subject, he can appease again every day of his life by some new execution. But we mistake it if we think otherwise than that, in spite of these distinct and very numerous nay daily gratifications if he so choose, it is not a life of fierce internal agony notwithstanding. It seems indispensable to the nature of every desire, and to form part indeed of its very idea, that there should be a distinctly felt pleasure, or at least, a removal at the time of a distinctly felt pain, in the act of its fulfilment—yet, whatever recreation or relief may have thus been rendered, without doing away the misery often in the whole amount of it the intense misery, inflicted upon man by the evil propensities of his nature. Who can doubt for example the unhappiness of the habitual drunkard? and that, although the ravenous appetite, by which he is driven along a stormy career, meets every day, almost every hour of the day, with the gratification that is suited to it. The same may be equally affirmed of the voluptuary, or of the depredator, or of the extortioner, or of the liar. Each may succeed in the attainment of his specific object; and we cannot possibly disjoin from the conception of success the conception of some sort of pleasure—yet in perfect consistency, we affirm, with a sad and heavy burthen of unpleasantness or unhappiness on the whole. He is little conversant with our nature who does not know of many a passion belonging to it, that it may be the instrument of many pleasurable, nay delicious or exquisite sensations, and yet be a wretched passion still; the domineering tyrant of a bondsman, who at once knows himself to be degraded, and feels himself to be unhappy. A sense of guilt is one main ingredient of this misery—yet physically, and notwithstanding the pleasure or the relief inseparable at the moment from every indulgence of the passions, there are other sensations of bitterness, which of themselves, and apart from remorse, would cause the suffering to preponderate.

6. There is an important discrimination made by Bishop Butler in his sermons; and, by the help of which, this phenomenon, of apparent contradiction or mystery in our nature, may be satisfactorily explained. He distinguishes between the final object of any of our desires, and the pleasure attendant on or rather inseparable from its gratification. The object is not the pleasure, though the pleasure be an unfailing and essential accompaniment on the attainment of the object. This is well illustrated by the appetite of hunger, of which it were more proper to say that it seeks for food, than that it seeks for the pleasure which there is in eating the food. The food is the object; the pleasure is the accompaniment. We do not here speak of the distinct and secondary pleasure which there is in the taste of food, but of that other pleasure which strictly and properly attaches to the gratification of the appetite of hunger. This is the pleasure, or relief, which accompanies the act of eating; while the ultimate object, the object in which the appetite rests and terminates, is the food itself. The same is true of all our special affections.

Each has a proper and peculiar object of its own, and the mere pleasure attendant on the prosecution or the indulgence of the affection is not, as has been clearly established by Butler and fully reasserted by Dr. Thomas Brown, is not that object. The two are as distinct from each other, as a thing loved is distinct from the pleasure of loving it. Every special inclination has its special and counterpart object. The object of the inclination is one thing; the pleasure of gratifying the inclination is another; and, in most instances, it were more proper to say, that it is for the sake of the object than for the sake of the pleasure that the inclination is gratified. The distinction that we now urge, though felt to be a subtle, is truly a substantial one; and pregnant, both with important principle and important application. The discovery and clear statement of it by Butler may well be regarded as the highest service rendered by any philosopher to moral science; and that, from the light which it casts, both on the processes of the human constitution and on the theory of virtue. As one example of the latter service, the principle in question, so plainly and convincingly unfolded by this great Christian philosopher in his sermon on the love of our neighbour, strikes, and with most conclusive effect, at the root of the selfish system of morals; a system which professes that man's sole object, in the practice of all the various moralities, is his own individual advantage. Now, in most cases of a special, and more particularly of a virtuous affection, it can be demonstrated, that the object is a something out of himself and distinct from himself. Take compassion for one instance out of the many. The object of this affection is the relief of another's misery, and, in the fulfilment of this, does the affection meet with its full solace and gratification; that is, in a something altogether external from himself. It is true, that there is an appropriate pleasure in the indulgence of this affection, even as there is in the indulgence of every other; and in proportion, too, to the strength of the affection, will be the greatness of the pleasure. The man who is doubly more compassionate than his fellow, will have doubly a greater enjoyment in the relief of misery; yet that, most assuredly, not because he of the two is the more intently set on his own gratification, but because he of the two is the more intently set on an outward accomplishment, the relief of another's wretchedness. The truth is, that, just because more compassionate than his fellow, the more intent is he than the other on the object of this affection, and the less intent is he than the other on himself the subject of this affection. His thoughts and feelings are more drawn away *to* the sufferer, and therefore more drawn away *from* himself. He is the most occupied with the object of this affection; and, on that very account, the least occupied with the pleasures of its indulgence. And it is precisely the objective quality of these regards, which stamps upon compassion the character of a disinterested affection. He surely is the most compassionate, whose thoughts and

feelings are most drawn away to the sufferer, and most drawn away from self; or, in other words, most taken up with the direct consideration of him who is the object of this affection, and least taken up with the reflex consideration of the pleasure that he himself has in the indulgence of it. Yet this prevents not the pleasure from being actually felt; and felt, too, in very proportion to the intensity of the compassion; or, in other words, more felt the less it has been thought of at the time, or the less it has been pursued for its own sake. It seems unavoidable in every affection, that, the more a thing is loved, the greater must be the pleasure of indulging the love of it: yet it is equally unavoidable, that the greater in that case will be our aim towards the object of the affection, and the less will be our aim towards the pleasure which accompanies its gratification. And thus, to one who reflects profoundly and carefully on these things, it is no paradox that he who has had doubly greater enjoyment than another in the exercise of compassion, is doubly the more disinterested of the two; that he has had the most pleasure in this affection who has been the least careful to please himself with the indulgence of it; that he whose virtuous desires, as being the strongest, have in their gratification ministered to self the greatest satisfaction, has been the least actuated of all his fellows by the wishes, and stood at the greatest distance from the aims of selfishness.*

7. And moreover, there is a just and philosophical sense, in which many of our special affections, besides the virtuous, are alike disinterested with these; even though they have been commonly ranked among the selfish affections of our nature. The proper object of self-love is the good of self; and this calm general regard to our own happiness may be considered, in fact, as the only interested affection to which our nature is competent. The special affections are, one and all of them, distinct from self-love, both in their objects, and in the real psychological character of the affections themselves. The object of the avaricious affection is the acquirement of wealth; of the resentful, the chastisement of an offender; of the sensual, something appropriate or suited to that corporeal affection which forms the reigning appetite at the time. In none of these, is the good of self the proper discriminative object of the affection; and the mind of him who is under their power, and engaged in their prosecution, is differently employed, from the mind of him, who, at the time, is either devising or doing aught for the general or abstract end of his own happiness. None of these special affections is identical with the affection which has happiness for its object. So far from this, the avaricious man often, conscious of the strength of his propensity, and at the moment of being urged forward by it to new speculations, acknowledges in his heart, that he would be happier far, could

* The purely disinterested character of a right religious affection might be proved by these considerations.

he but moderate its violence, and be satisfied with an humbler fortune than that to which his aspirations would carry him. And the resentful man, in the very act of being tempest-driven to some furious onset against the person who has affronted or betrayed him, may yet be sensible that, instead of seeking for any benefit to himself, he is rushing on the destruction of his character, or fortune, or even life. And many is the drunkard who under the goadings of an appetite which he cannot withstand, in place of self-love being the principle, and his own greatest happiness the object, knows himself to be on the road to inevitable ruin. There is an affection which has happiness for its object; but this is not the affection which rules and has the ascendancy in any of these instances. These are all special affections, grounded on the affinities which obtain between certain objects and certain parts of human nature; and which cannot be indulged beyond a given extent, without distemper and discomfort to the whole nature; so that, in spite of all the particular gratifications which follow in their train, the man over whom they tyrannize may be unhappy upon the whole. The very distinction between the affection of self-love and the special affections proves that there is a corresponding distinction in their objects; and this again, that many of the latter may be gratified, while the former is disappointed,—or, in other words, that, along with many particular enjoyments the general state of man may be that of utter and extreme wretchedness. It is therefore a competent question, what those special affections are, which most consist with the general happiness of the mind; and this, notwithstanding that they all possess one circumstance in common—the unavoidable pleasure appendant to the gratification of each of them.*

* The following are the clear and judicious observations of Sir James Mackintosh on this subject:—

“In contending, therefore, that the benevolent affections are disinterested, no more is claimed for them than must be granted to mere animal appetites and to malevolent passions. Each of these principles alike seeks its own object, for the sake simply of obtaining it. Pleasure is the result of the attainment, but no separate part of the aim of the agent. The desire that another person may be gratified, seeks that outward object alone, according to the general course of human desire. Resentment is as disinterested as gratitude or pity, but not more so. Hunger or thirst may be as much as the purest benevolence, at variance with self-love. A regard to our own general happiness is not a vice, but in itself an excellent quality. It were well if it prevailed more generally over craving and short-sighted appetites. The weakness of the social affections, and the strength of the private desires, properly constitute selfishness; a vice utterly at variance with the happiness of him who harbours it, and as such, condemned by self-love. There are as few who attain the greatest satisfaction to themselves, as who do the greatest good to others. It is absurd to say with some, that the pleasure of benevolence is selfish, because it is felt by self. Understanding and reasoning are acts of self, for no man can think by proxy; but no man ever called them *selfish*, why? Evidently because they do not *regard* self. Precisely the same reason applies to benevolence. Such an argument is a gross confusion of self, as it is a *subject* of feeling or thought, with self considered as the *object* of either. It is no more just to refer the private appetites to self-love because they commonly promote happiness, than it would be to refer them to self-hatred, in those frequent cases where their gratification obstructs it.”

8. This explanation will help us to understand wherein it is that the distinction in point of enjoyment, between a good and an evil affection of our nature properly lies. For there is a certain species of enjoyment common to them all. It were a contradiction in terms to affirm otherwise; for it were tantamount to saying, that an affection may be gratified, without the actual experience of a gratification. There must be some sensation or other of happiness, at the time when a man obtains that which he is seeking for; and if it be not a positive sensation of pleasure, it will at least be the sensation of a relief from pain, as when one meets with the opportunity of wreaking upon its object, that indignation which had long kept his heart in a tumult of disquietude. We therefore would mistake the matter, if we thought, that a state even of thorough and unqualified wickedness was exclusive of all enjoyment—for even the vicious affections must share in that enjoyment, which inseparably attaches to every affection, at the moment of its indulgence. And thus it is, that even in the veriest Pandemonium, might there be lurid gleams of ecstasy, and shouts of fiendish exultation—the merriment of desperadoes in crime, who send forth the outcries of their spiteful and savage delight, when some deep-laid villany has triumphed; or when, in some dire perpetration of revenge, they have given full satisfaction and discharge to the malignity of their accursed nature. The assertion therefore may be taken too generally, when it is stated, that there is no enjoyment whatever in the veriest hell of assembled outcasts; for even there, might there be many separate and specific gratifications. And we must abstract the pleasure essentially involved in every affection, at the instant of its indulgence, and which cannot possibly be disjoined from it, ere we see clearly and distinctively wherein it is that, in respect of enjoyment, the virtuous and vicious affections differ from each other. For it is true, that there is a common resemblance between them; and that, by the universal law and nature of affection, there must be some sort of agreeable sensation, in the act of their obtaining that which they are seeking after. Yet it is no less true, that, did the former affections bear supreme rule in the heart, they would brighten and tranquillize the whole of human existence—whereas, had the latter the entire and practical ascendancy, they would distemper the whole man, and make him as completely wretched as he were completely worthless.

9. There is one leading difference then between a virtuous and a vicious affection—that there is always a felt sweetness in the very presence and contact of the former; whereas, in the presence and contact of the latter, there is generally or very often at least, a sensation of bitterness. Let them agree as they may in the undoubted fact of a gratification in the attainment of their respective ends, the affections themselves may be long in existence and operation before their ends are arrived at; and then it is, we affirm, that if compared,

there will be found a wide distinction and dissimilarity between them. The very feeling of kindness is pleasant to the heart; and the very feeling of anger is a painful and corrosive one. The latter, we know, is often said to be a mixed feeling—because of both the pleasure and the pain which are said to enter into it. But it will be found that the pleasure, in this case, lies in the prospect of a full and final gratification; and very often, in a sort of current or partial gratification which one may experience beforehand, in the mere vent or utterance by words, of the labouring violence that is within—seeing that words of bitterness, when discharged on the object of our wrath, are sometimes the only, and even the most effective executioners of all the vengeance that we meditate; besides that by their means, we may enlist in our favour the grateful sympathy of other men—thus obtaining a solace to ourselves, and aggravating the punishment of the offender, by exciting against him, in addition to our own hostility, the hostile indignation of his fellows. And thus too is it, that, in the case of anger, there may not only be a completed gratification at the last, by the infliction of a full and satisfactory chastisement; but a gratification, as it were by instalments, with every likely purpose of retaliation that we may form in our bosoms, and every sentence of keen and reproachful eloquence that may fall from our lips. And so anger has been affirmed to be a mixed emotion, from confounding the pleasure that lies in the gratification of the emotion, with the pleasure that is supposed to lie in the feeling of the emotion. But the truth is, that, apart from the gratification, the emotion is an exceedingly painful one—insomuch that the gratification mainly lies in the removal of a pain, or in the being ridded of a felt uneasiness. Compassion may in the same way be termed a mixed feeling. But on close attention to these two affections and comparison between them, it will be found, that all the pleasure of anger lies in its gratification, and all the pain of it in the feeling itself—whereas all the pain of compassion lies in the disappointment of its gratification, while in the feeling itself there is nought but pleasure. Let the respective gratifications of these two affections—the one, by the fulfilled retaliation of a wrong; the other, by the fulfilled relief of a suffering—let these gratifications be put out of notice altogether, that we might but attend to the yet ungratified feelings themselves: and we cannot imagine a greater difference of state between two minds, than that of one which luxuriates in the tenderness of compassion, and that of another which breathes and is infuriated with the dark passions and the still darker purposes of resentment. Or we may appeal to the experience of the same mind, which at one time may have its hour of meditated kindness, and at another its hour of meditated revenge. We speak of these two, not in the moment of their respective triumphs, not of the sensations attendant on the success of each—but of the direct and instant sensations which lie in the feelings themselves. They form two as

distinct states in the moral world, as sunshine and tempest are in the physical world. We have but to name the elements which enter into the composition of each, in order to suggest the utter contrariety which obtains between them—between the calm and placid cheerfulness on the one hand of that heart which is employed in conceiving the generous wishes, or in framing the liberal and fruitful devices of benevolence; and, on the other hand, the turbulence and fierce disorder of the same heart, when burning disdain, or fell and implacable hatred has taken possession of it—the reaction of its own affronted pride, or aggrieved sense of the injury which has been done to it.

10. But perhaps the most favourable moment for comparison between them, is when each is frustrated of its peculiar aim; and so each is sent back upon itself, with that common suffering to which all the affections are liable—the suffering of a disappointment. We shall be at no loss to determine on which side the advantage lies, if we have either felt or witnessed benevolence in tears, because of the misery which it cannot alleviate; and rage, in the agonies of its defeated impotence, because of the haughty or successful defiance of an enemy, whom with vain hostility it has tried to assail, but cannot reach. We have the example of a good affection under disappointment, in the case of virtuous grief or virtuous indignation; and of a bad affection under disappointment, in the case of envy, when, in spite of every attempt to calumniate or depress its object, he shines forth to universal acknowledgment and applause, in all the lustre of his vindicated superiority. It marks how distinct these two sets of feelings are from each other, that, with the former, even under the pain of disappointment, there is a something in the very taste and quality of the feelings themselves, which acts as an emollient or a charm, and mitigates the painfulness—while, with the latter, there is nought to mitigate, but everything to exasperate, and more fiercely to agonize. The malignant feelings are no sooner turned inwardly, by the arrest of a disappointment from without, than they eat inwardly; and, when foiled in the discharge of their purposed violence upon others, they recoil—and, without one soothing ingredient to calm the labouring effervescence, they kindle a hell in the heart of the unhappy owner. Internally, there is a celestial peace and satisfaction in virtue, even though in the midst of its outward discomfiture, it may be compelled to weep over the unredressed wrongs and sufferings of humanity. On the other hand, the very glance of disappointed malevolence, bespeaks of this evil affection, that, of itself, it is a fierce and fretting distemper of the soul, an executioner of vengeance for all the guilty passions it may have fanned into mischievous activity, and for all the crimes it may have instigated.

11. And this contrast between a good and an evil affection, this superiority of the former to the latter is fully sustained, when, instead of looking to the state of mind which is left by the disappointment

of each, we look to the state of mind which is left by their respective gratifications—the one a state of sated compassion, the other of sated resentment. There is one most observable distinction between the states of feeling, by which an act of compassion on the one hand, and of resentment on the other, are succeeded. It is seldom that man feasts his eyes on that spectacle of prostrate suffering which, in a moment of fury, he hath laid at his feet; in the same way that he feasts his eyes on that picture of family comfort which smiles upon him from some cottage home, that his generosity had reared. This looks as if the sweets of benevolence were lasting, whereas the sweets of revengeful malice, such as they are, are in general but momentary. An act of compassion may extinguish for a time the feeling of a compassion, by doing away that suffering which is the object of it; but then it generally is followed up by a feeling of permanent regard. An act of revenge, when executed to the full extent of the desire or purpose, does extinguish and put an end to the passion of revenge; and is seldom, if ever, followed up by a feeling of permanent hatred. An act of kindness but attaches the more, and augments a friendly disposition towards its object. It were both untrue in itself, and unfair to our nature to say, that an act of revenge but exasperates the more, and always augments, or even often augments, a hostile disposition towards its object. It has been said that we hate the man whom we have injured: but whatever the truth of this observation may be, certain it is, that we do not so hate the man of whom we have taken full satisfaction for having injured us: or, if we could imagine aught so monstrous, and happily so rare, as the prolonged, the yet unquelled satisfaction of one, who could be regaled for hours with the sighs of him whom his own hands had wounded; or, for months and years, with the pining destitution of the household whom himself had impoverished and brought low; this were because the measure of the revenge had not equalled the measure of the felt provocation, only perhaps to be appeased and satiated by death. This, at length, would terminate the emotion. And here a new insight opens upon us into the distinction between a good and a bad affection. Benevolence, itself of immortal quality, would immortalize its objects: malignity, if not appeased by an infliction short of death, would destroy them.* The one is ever strengthening itself upon old objects, and fastening upon new ones; the other is ever extinguishing its resentment towards old objects by the pettier acts of chastisement, or, if nothing short of a capital punishment will appease it, by dying with their death. The exterminating blow, the death which “clears all scores”—this forms the natural and necessary limit even to the fiercest revenge; whereas, the outgoings of benevolence are quite indefinite. In revenge, the affection is successively extinguish-

* So true it is, that he who hateth his brother with implacable hatred is a murderer.

ed; and, if returned, it is upon new objects. In benevolence, the affection is kept up for old objects, while ever open to excitement from new ones; and hence a living and multiplying power of enjoyment, which is peculiarly its own. On the same principle that we water a shrub just because we had planted it, does our friendship grow and ripen the more towards him on whom we had formerly exercised it. The affection of kindness for each individual object survives the act of kindness, or, rather, is strengthened by the act. Whatever sweetness may have been originally in it, is enhanced by the exercise; and, so far from being stifled by the first gratification, it remains in greater freshness than ever for higher and larger gratifications than before. It is the perennial quality of their gratification, which stamps that superiority on the good affections, we are now contending for. Benevolence both perpetuates itself upon its old objects, and expands itself into a wider circle as it meets with new ones. Not so with revenge, which generally disposes of the old object by one gratification; and then must transfer itself to a new object, ere it can meet with another gratification. Let us grant that each affection has its peculiar walk of enjoyment. The history of the one walk presents us with a series of accumulations; the history of the other with a series of extinctions.

12. But in dwelling on this beautiful peculiarity, by which a good affection is distinguished from a bad one, we are in danger of weakening our immediate argument. We bring forward the matter a great deal too favourably for the malignant desires of the human heart, if, while reasoning on the supposition of an enjoyment, however transitory in their gratification, we give any room for the imagination that even this is unmixed enjoyment. We have already stated, that, of themselves and anterior to their gratification, there is a painfulness in these desires; and that when by their gratification we get quit of this painfulness, we might after all obtain little more than a relief from misery. But the truth is, that, generally speaking, we obtain a great deal less on the side of happiness than this; for, in most cases, all that we obtain by the gratification of a malignant passion, is but the exchange of one misery for another; and this apart still from the remorse of an evil perpetration. There is one familiar instance of it, which often occurs in conversation—when, piqued by something offensive in the remark or manner of our fellows, we react with a severity which humbles and overwhelms him. In this case, the pain of the resentment is succeeded by the pain we feel in the spectacle of that distress which ourselves have created: and this, too, aggravated perhaps by the reprobation of all the bystanders, affording thereby a miniature example of the painful alternations which are constantly taking place in the history of moral evil; when the misery of wrong affections is but replaced, to the perpetrator himself, by the misery of the wrong actions to which they have hurried him. It is thus that a life of frequent gratification

may, notwithstanding, be a life of intense wretchedness. It may help our imagination of such a state, to conceive of one, subject every hour to the agonies of hunger, with such a mal-conformation at the same time in his organ of taste, that, in food of every description, he felt a bitter and universal nausea. There were here a constant gratification, yet a constant and severe endurance—a mere alternation of cruel sufferings—the displacement of one set of agonies, by the substitution of other agonies in their room. This is seldom, perhaps never, realized in the physical world; but in the moral world it is a great and general phenomenon. The example shows at least the possibility of a constitution, under which a series of incessant gratifications may be nothing better than a restless succession of distress and disquietude; and that such should be the constitution of our moral nature as to make a life of vice a life of vanity and cruel vexation, is strong experimental evidence of Him who ordained this constitution, that He hateth iniquity, that He loveth righteousness.

13. But the peculiarity which we have been incidentally led to notice, is, in itself, pregnant with inference also. We should augur hopefully of the final issues of our moral constitution, as well as conclude favourably of Him who hath ordained it—when we find its workings to be such, that, on the one hand, the feeling of kindness towards an individual object, not only survives, but is indefinitely strengthened by the acts of kindness; and, on the other hand, that, not only does an act of revenge satiate and put an end to the feeling of revenge, but even, that certain acts of hostility towards the individual object of our hatred will make us relent from this hatred, and at length extinguish it altogether. May we not perceive in this economy a balance in point of tendency, and at length of ultimate effect on the side of virtue? May it not warrant the expectation, that, while benevolence, that great conservative principle of being, has in it a principle conservative of itself as well as of its objects, the outbreaks of evil are but partial and temporary; and that the moral world, viewed as a progressive system and now only in its transition state, has been so constructed as to secure both the perpetuity of all the good affections and the indefinite expansion of them to new objects and over a larger and ever-widening territory? At all events, whatever reason there may be to fear, that, in the future arrangements of nature and providence, both virtue and vice will be capable of immortality—we might gather from what passes under our eyes, in this rudimental and incipient stage of human existence, that even with our present constitution virtue alone is capable of a blissful immortality. For malice and falsehood carry in them the seeds of their own wretchedness, if not of their own destruction. Only grant the soul to be imperishable; and if the character of the governor is to be gathered from the final issues of the government over which he presides—it says much for the moral

character of Him who framed us, that, unless there be an utter reversal of the nature which Himself has given, then, in respect to the power of conferring enjoyment or of maintaining the soul in its healthiest and happiest mood, it is righteousness alone which endureth for ever, and charity alone which never faileth.

14. And beside taking account of the special enjoyments which attach to the special virtues, we might observe on the general state of that mind, which, under the consistent and comprehensive principle of being or doing what it ought, studies rightly to acquit itself of all the moral obligations. Beside the perpetual feast of an approving conscience, and the constant recurrence of those particular gratifications which attach to the indulgence of every good affection,—is it not quite obvious of every mind which places itself under a supreme regimen of morality, that then, it is in its best possible condition with regard to enjoyment: like a well strung instrument, in right and proper tone, because all its parts are put in right adjustment with each other? If conscience be indeed the superior faculty of our nature, then, every time it is cast down from this pre-eminence, there must be a sensation of painful dissonance; and the whole man feels out of sorts, as one unhinged or denaturalized. This perhaps is the main reason that a state of well-doing stands associated with a state of well-being; and why the special virtue of temperance is not more closely associated with the health of the body, than the general habit of virtue is with a wholesome and well-conditioned state of the soul. There is then no derangement as it were in the system of our nature—all the powers, whether superior or subordinate, being in their right places, and all moving without discord and without dislocation. It were anticipating our argument, did we refer at present to the confidence and regard wherewith a virtuous man is surrounded in the world. We have not yet spoken of the adaptations to man's moral constitution from without, but only of the inward pleasures and satisfactions which are yielded in the workings of the constitution itself. And surely when we find it to have been so constructed and attuned by its maker, that, in all the movements of virtue there is a felt and grateful harmony, while a certain jarring sense of violence and discomposure ever attends upon the opposite—we cannot imagine how the moral character of that being who Himself devised this constitution and established all its tendencies, can be more clearly or convincingly read, than in phenomena like these.

15. We have already said that the distinction so well established by Butler, between the object of our affection and its accompanying, nay, inseparable pleasure, was the most effectual argument that could be brought to bear against the selfish system of morals. The virtuous affection that is in a man's breast simply leads him to do what he ought; and in that object he rests and terminates. Like every other affection, there must be a pleasure conjoined with the

prosecution of it; and at last a full and final gratification in the attainment of its object. But the object must be distinct from the pleasure, which itself is founded on a prior suitability between the mind and its object. When a man is actuated by a virtuous desire; it is the virtue itself that he is seeking, and not the gratification that is in it. His single object is to be or to do rightly—though, the more intent he is upon this object, the greater will, the greater must be his satisfaction if he succeed in it. Nevertheless, it is not the satisfaction which he is seeking; it is the object which yields the satisfaction—the object too for its own sake, and not for the sake of its accompanying or its resulting enjoyment. Nay, the more strongly and therefore the more exclusively set upon virtue for its own sake; the less will he think of its enjoyment, and yet the greater will his actual enjoyment be. In other words, virtue, the more disinterested it is, is the more prolific of happiness to him who follows it; and then it is, that, when freed from all the taints of mercenary selfishness, it yields to its votary the most perfect and supreme enjoyment. Such is the constitution of our nature, that virtue loses not its disinterested character; and yet man loses not his reward; and the author of this constitution, He who hath ordained all its laws and its consequences, has given signal proof of His own supreme regard for virtue, and therefore, of the supreme virtue of His own character, in that He hath so framed the creatures of His will, as that their perfect goodness and perfect happiness are at one. Yet the union of these does not constitute their unity. The union is a contingent appointment of the Deity; and so is at once the evidence and the effect of the goodness that is in His own nature.

16. This then is our second general argument for the moral character of God, grounded on the moral constitution of man; and prior, as yet, to any view of its adaptation to external nature. It is distinct from the first argument, as grounded on the phenomena of conscience, which assumes the office of judge within the breast, all whose decisions are on the side of benevolence and justice; and which is ever armed with a certain power of enforcement, both in the pains of remorse and the pleasures of self-approbation. These, however, are distinct and ought to be distinguished from the direct pleasures of virtue in itself, and the direct pains of vice in itself, which form truly separate ingredients, on the one hand of a present and often very painful correction, on the other hand, of a present and very precious reward.

CHAPTER III.

THIRD GENERAL ARGUMENT.

The Power and Operation of Habit.

1. WE have as yet been occupied with what may be termed the instant sensations, wherewith morality is beset in the mind of man—with the voice of conscience which goes immediately before, or with the sentence whether of approval or condemnation, which comes immediately after it; and latterly, with those states of feeling which are experienced at the moment when under the power of those affections, to which any moral designation, be it of virtue or vice, is applicable—the pleasure which there is in the very presence and contact of the one, the distaste, the bitterness which there is in the presence and contact of the other.

2. These phenomena of juxtaposition, as they may be termed; these contiguous antecedents and consequents of the moral and the immoral in man, speak strongly the purpose of Him who ordained our mental constitution, in having inserted there such a constant power of command and encouragement on the side of the former, and a like constant operation of checks and discouragement against the latter. But, perhaps, something more may be collected of the design and character of God, by stretching forward our observation prospectively in the history of man, and so extending our regards to the more distant consequences of virtue or vice, both on the frame of his character and the state of his enjoyments. By studying these posterior results, we approximate our views towards the final issues of that administration under which we are placed. That defensive apparatus, wherewith the embryo seed of plants is guarded and protected, might indicate a special care or design in the preserver of it. What that design particularly is comes to be clearly and certainly known, when, in the future history of the plant, we learn what the functions of the seed are, after it has come to maturity; and then observe, that, had it been suffered universally to perish, it would have led,—not to the mortality of the individual, for that is already an inevitable law, but to the extinction and mortality of the species.

3. For tracing forward man's moral history, or the changes which take place in his moral state, it is necessary that we should advert to the influence of habit. Yet it is not properly the philosophy of habit wherewith our argument is concerned, but with the leading facts of its practical operation. A beneficial effect might still remain an evidence of the divine goodness, by whatever steps it should be efficiently or physically brought about—its power in this way depending not on the question how it is, but on the fact that so it is.

It were really, therefore, deviating from our own strict and pertinent line of inquiry, did we stop to discuss the philosophic theory of habit, or suspend our own independent reasoning till that theory was settled—beside most unwisely and unnecessarily attaching to our theme, all the discredit of an obscure or questionable speculation. It is with palpable and sure results both in the material and mental world, more than with the recondite processes in either, that theism has chiefly to do; and it by the former more than by the latter that the cause of theism is upholden.

4. We might only observe, in passing, that the modification introduced by Dr. Thomas Brown into the theory of habit, was perhaps uncalled for, even for the accomplishment of his own purpose, which was to demonstrate that it required no peculiar or original law of the human constitution to account for its phenomena. He resolves, and we are disposed to think rightly, the whole operation of habit into the law of suggestion—only, he would extend that law to states of feelings, as well as to thoughts or to states of thoughts.* We are all aware that if two objects have been seen or thought of together on any former occasion, then the thought of one of them is apt to suggest the thought of the other, and the more apt the more frequently that the suggestion has taken place—insomuch, that, if the suggestion have taken place very often, we shall find it extremely difficult, if not impossible, to break the succession between the thought which suggests and the thought which is suggested by it. Now Dr. Brown has conceived it necessary to extend this principle to feelings as well as thoughts—insomuch, that, if on a former occasion a certain object have been followed up by a certain feeling, or even if one feeling have been followed up by another, then the thought of the object introduces the feeling, or the one feeling introduces the other feeling into the mind, on the same principle that thought introduces thought. Now we should rather be inclined to hold that thought introduces feeling, not in consequence of the same law of suggestion whereby thought introduces thought, but in virtue of the direct power which lies in the object of the thought to excite that feeling. When a voluptuous object awakens a voluptuous feeling, this is not by suggestion, but by a direct influence of its own. When the picture of that voluptuous object awakens the same volup-

* The following is the passage taken from his forty-third lecture, in which Dr. Brown seems to connect feeling with feeling by the same mental law which connects thought with thought. "To explain the influence of habit in increasing the tendency to certain actions I must remark—what I have already more than once repeated—that the suggesting influence which is usually expressed in the phrase *association of ideas*, though that very improper phrase would seem to limit it to our ideas or conceptions only, and has unquestionably produced a mistaken belief of this partial operation of a general influence—is not limited to those more than to any other states of mind, but occurs also with equal force in other feelings, which are not commonly termed ideas or conceptions; that our desires or other emotions, for example, may, like them, form a part of our trains of suggestion," &c. See another equally ambiguous passage in his sixty-fourth lecture.

tuous feeling, we would not ascribe it to suggestion, but still put it down to the power of the object, whether presented or only represented, to awaken certain emotions. And as little would we ascribe the excitement of the feeling to suggestion, but still to the direct and original power of the object—though it were pictured to us only in thought, instead of being pictured to us in visible imagery. In like manner, when the thought of an injury awakens in us anger, even as the injury itself did at the moment of its infliction, we should not ascribe this to that peculiar law which is termed the law of suggestion, and which undoubtedly connects thought with thought. But we should ascribe it wholly to that law which connects an object with its appropriate emotion—whether that object be present to the senses, or have only been recalled by the memory and is present to the thoughts. We sustain an injury, and we feel resentment in consequence, without, surely, the law of suggestion having had ought to do with the sequence. We see the aggressor afterwards, and our anger is revived against him, and with this particular succession the law of suggestion has certainly had to do—not, however, in the way of thought suggesting feeling, but only in the way of thought suggesting thought. In truth it is a succession of three terms. The sight of the man awakens a recollection of the injury; and the thought of the injury awakens the emotion. The first sequence, or that which obtains between the first and second term, is a pure instance of the suggestion of thought by thought, or, to speak in the old language, of the association of ideas. The second sequence, or that which obtains between the middle and last term, is still, Dr. Brown would say, an instance of suggestion, but of thought suggesting the feeling wherewith it was formerly accompanied. Whereas, in our apprehension, it is due, not to the law of suggestion but to the law which connects an object, whether present at the time or thought upon afterwards, with its counterpart emotion. Still the result is the same, however differently accounted for. One can think, surely, of the resentment which now occupies him, as well as he can think of a past resentment—indeed it is difficult to imagine how he can feel a resentment without thinking of it. Let some one thought, then, by the proper law of suggestion, have introduced the thought of an injury that had been done to us; this second thought introduces the feeling of resentment, not by the law of suggestion, but by the law which relates an object, whether present or thought upon, to its appropriate emotion; this emotion is thought upon, and not the emotion, but the thought of the emotion recalls the thought of the first emotion that was felt at the original infliction of the injury; and this thought again recalls to us the thought of the injury itself, and perhaps the thought of other or similar injuries, which, as at the first, excites anew the feeling of anger, but, at this particular step, by means of a law different from that of suggestion, even the law of our emotions, in virtue of which, certain objects, when present in

any way to the cognisance of the understanding, awaken certain sensibilities in the heart. It is thus that thoughts and feelings might reciprocally introduce each other, not by means of but one law of suggestion extending in common to them both, but by the intermingling of two laws in this repeating or circulating process,—even the law of suggestion, acting only upon the thoughts; and the law of emotion, by which certain objects, when presented to the senses or to the memory, have the power to awaken certain correspondent emotions. We in this way get quit of the mysticism which attaches to the notion of mere feelings either suggesting or being suggested by other feelings, separately from thoughts—more especially when, by the association of thoughts or of ideas alone, and the direct power which lies in the objects of these ideas to awaken certain emotions, all the phenomena are capable of being explained. A certain thought or object may suggest the thought of a former provocation; this thought might excite a feeling of resentment; the resentment, thus felt or thought upon, might send back the mind to a still more vivid impression of its original cause; and this again might prolong or waken the resentment anew, and in greater freshness than before. The ultimate effect might be a fierce and fiery effervescence of irascible feeling. Yet not by the operation of one law, but of two distinct laws in the human constitution; the first that, in virtue of which, thoughts suggest thoughts; the second that, in virtue of which, the object thus thought upon awakens the emotion that is suited to it.

5. But though for once we have thus adverted to the strict philosophy of the subject, it will be apparent, that, in this instance, it is of no practical necessity for the purposes of our argument; and it is truly the same in many other instances, where, if instead of reasoning theologically on the palpable operations of the mechanism, we should reason scientifically on the *modus operandi*, we would run into really irrelevant discussions. The theme of our present chapter is the effect of Habit, in as far as these effects serve to indicate the design or character of Him who is the author of our mental constitution. It matters not to any conclusion of ours, by what recondite, or, it may be, yet undiscovered process these effects are brought about; and whether the common theory, or that of Dr. Brown, or that again as modified, and corrected by ourselves, is the just one. It is enough to know, that, if any given process of intermingled thought and feeling have been described by us once, there are laws at work, which, on the first step of that process again recurring, would incline us to describe the whole of the process over again; and with the greater power and certainty, the more frequently that process has been repeated. We are perfectly sure that the more frequently any particular sequence between thought and thought may have occurred, the more readily will it recur;—so that when once the first thought has entered the mind, we may all the more

confidently reckon on its being followed up by the second. This we hold enough for explaining the ever recurring force and facility, wherewith feelings also will arise and be followed up by their indulgence—and that, just in proportion to the frequency wherewith in given circumstances they have been awakened and indulged formerly. In as far as the objects of gratification are the exciting causes which stimulate and awaken the desires of gratification; then, any process which insures the presence and application of the causes, will also insure the fulfilment of the effects which result from them. If it be the presence or perception of the wine that stands before us which stirs up the appetite; and if, instead of acting on the precept of looking not unto the wine when it is red, we continue to look till the appetite be so inflamed that the indulgence becomes inevitable—then, as we looked at it continuously when present, will we, by the law of suggestion, be apt to think of it continuously when absent. If the one continuity was not broken by any considerations of principle or prudence—so the less readily will the other continuity be broken in like manner. When we revisit the next social company, we shall probably resign ourselves to the very order of sensations that we did formerly; and the more surely, the oftener that that order has already been described by us. And as the order of objects with their sensations when present, so is the order of thoughts with their desires when absent. This order forces itself upon the mind with a strength proportional to the frequency of its repetition; and desires, when not evaded by the mind shifting its attention away from the objects of them, can only be appeased by their indulgence.

6. It is thus that he who enters on a career of vice, enters on a career of headlong degeneracy. If even for once we have described that process of thought and feeling, which leads, whether through the imagination or the senses, from the first presentation of a tempting object to a guilty indulgence—this of itself establishes a probability, that, on the recurrence of that object, we shall pass onward by the same steps to the same consummation. And it is a probability ever strengthening with every repetition of the process, till at length it advances towards the moral certainty of a helpless surrender to the tyranny of those evil passions, which we cannot resist, just because the will itself is in thralldom, and we choose not to resist them. It is thus that we might trace the progress of intemperance and licentiousness, and even of dishonesty, to whose respective solicitations we have yielded at the first—till, by continuing to yield, we become the passive, the prostrate subjects of a force that is uncontrollable, only because we have seldom or never in good earnest tried to control it. It is not that we are struck of a sudden with moral impotency: but we are gradually benumbed into it. The power of temptation has not made instant seizure upon the faculties, or taken them by storm. It proceeds by an influence that is gently and almost insensibly progressive—just as progressive in truth, as

the association between particular ideas is strengthened by the frequency of their succession. But even as that association may at length become inveterate, insomuch that when the first idea finds entry into the mind, we cannot withstand the importunity wherewith the second insists upon following it; so might the moral habit become alike inveterate—thoughts succeeding thoughts, and urging onward their counterpart desires, in that wonted order, which had hitherto connected the beginning of a temptation with its full and final victory. At each repetition, would we find it more difficult to break this order, or to lay an arrest upon it—till at length, as the fruit of this wretched regimen, its unhappy patient is lorded over by a power of moral evil, which possesses the whole man, and wields an irresistible or rather an unresisted ascendancy over him.

7. But this melancholy process, leading to a vicious indulgence, may be counteracted by an opposite process of resistance, though with far greater facility at the first—yet a facility ever augmenting, in proportion as the effectual resistance of temptation is persevered in. That balancing moment, at which pleasure would allure, and conscience is urging us to refrain, may be regarded as the point of departure or divergency, whence one or other of the two processes will take their commencement. Each of them consists in a particular succession of ideas with their attendant feelings; and whichever of them may happen to be described once, has, by the law of suggestion, the greater chance, in the same circumstances, of being described over again. Should the mind dwell on an object of allure-ment, and the considerations of principle not be entertained—it will pass onward from the first incitement to the final and guilty indulgence by a series of stepping-stones, each of which will present itself more readily in future; and with less chance of arrest or interruption by the suggestions of conscience than before. But should these suggestions be admitted, and far more should they prevail—then, on the principle of association, will they be all the more apt to intervene, on the repetition of the same circumstances; and again break that line of continuity, which but for this intervention, would have led from a temptation to a turpitude or a crime. If on the occurrence of a temptation formerly, conscience did interpose, and represent the evil of a compliance, and so impress the man with a sense of obligation, as led him to dismiss the fascinating object from the presence of his mind, or to hurry away from it—the likelihood is, that the recurrence of a similar temptation will suggest the same train of thoughts and feelings and lead to the same beneficial result; and this is a likelihood ever increasing with every repetition of the process. The train which would have terminated in a vicious indulgence, is dispossessed by the train which conducts to a resolution and an act of virtuous self-denial. The thoughts which tend to awaken emotions and purposes on the side of duty find readier entrance into the mind; and the thoughts which awaken and urge forward the desire of what

is evil more readily give way. The positive force on the side of virtue is augmented, by every repetition of the train which leads to a virtuous determination. The resistance to this force on the side of vice is weakened, in proportion to the frequency wherewith that train of suggestions which would have led to a vicious indulgence, is broken and discomfited. It is thus that when one is successively resolute in his opposition to evil, the power of making the achievement and the facility of the achievement itself are both upon the increase; and virtue makes double gain to herself, by every separate conquest which she may have won. The humbler attainments of moral worth are first mastered and secured; and the aspiring disciple may pass onward in a career that is quite indefinite to nobler deeds and nobler sacrifices.

8. And this law of habit when enlisted on the side of righteousness, not only strengthens and makes sure our resistance to vice, but facilitates the most arduous performances of virtue. The man whose thoughts, with the purposes and doings to which they lead, are at the bidding of conscience, will, by frequent repetition, at length describe the same track almost spontaneously—even as in physical education, things, laboriously learned at the first, come to be done at last without the feeling of an effort. And so, in moral education, every new achievement of principle smooths the way to future achievements of the same kind; and the precious fruit or purchase of each moral victory is to set us on higher and firmer vantage-ground for the conquests of principle in all time coming. He who resolutely bids away the suggestions of avarice, when they come into conflict with the incumbent generosity; or the suggestions of voluptuousness, when they come into conflict with the incumbent self-denial; or the suggestions of anger, when they come into conflict with the incumbent act of magnanimity and forbearance—will at length obtain, not a respite only, but a final deliverance from their intrusion. Conscience, the longer it has made way over the obstacles of selfishness and passion—the less will it give way to these adverse forces, themselves weakened by the repeated defeats which they have sustained in the warfare of moral discipline: Or, in other words, the oftener that conscience makes good the supremacy which she claims—the greater would be the work of violence, and less the strength for its accomplishment, to cast her down from that station of practical guidance and command which of right belongs to her. It is just because, in virtue of the law of suggestion, those trains of thought and feeling, which connect her first biddings with their final execution, are the less exposed at every new instance to be disturbed, and the more likely to be repeated over again, that every good principle is more strengthened by its exercise, and every good affection is more strengthened by its indulgence than before. The acts of virtue ripen into habits; and the goodly and permanent result is, the formation or establishment of a virtuous character.

9. This then forms the subject of our third general argument. The voice of authority within, bidding us to virtue; and the immediate delights attendant on obedience, certainly, speak strongly for the moral character of that administration under which we are placed. But, by looking to posterior and permanent results, we have the advantage of viewing the system of that administration in progress. Instead of the insulated acts, we are led to regard the abiding and the accumulating consequences—and by stretching forward our observation through larger intervals and to more distant points in the moral history of men; we are in likelier circumstances for obtaining a glimpse of their final destination; and so of seizing on this mighty and mysterious secret—the reigning policy of the divine government, whence we might collect the character of Him who hath ordained it. And surely, it is of prime importance to be noted in this examination, that by every act of virtue we become more powerful for its service; and by every act of vice we become more helplessly its slaves. Or, in other words, were these respective moral regimens fully developed into their respective consummations, it would seem, as if by the one, we should be conducted to that state, where the faculty, within, which is felt to be the rightful, would also become the reigning sovereign, and then we should have the full enjoyment of all the harmony and happiness attendant upon virtue—whereas, by the other, those passions of our nature felt to be inferior, would obtain the lawless ascendancy, and subject their wretched bondsmen to the turbulence, and the agony, and the sense of degradation, which, by the very constitution of our being, are inseparable from the reign of moral evil.

10. We might not fully comprehend the design or meaning of a process, till we have seen the end of it. Had there been no death, the mystery of our present state might have been somewhat alleviated. We might then have seen, in bolder relief and indelible character, the respective consummations of vice and virtue—perhaps the world partitioned into distinct moral territories, where the habit of many centuries had given fixture and establishment, first, to a society of the upright, now in the firm possession of all goodness, as the well-earned result of that wholesome discipline through which they had passed; and, second, to a society of the reprobate, now hardened in all iniquity, and abandoned to the violence of evil passions no longer to be controlled and never to be eradicated. We might then have witnessed the peace, the contentment, and the universal confidence and love, the melody of soul, that reigned in the dwellings of the righteous; and contrasted these with the inquietudes, the strifes, the fell and fierce collisions of injustice and mutual disdain and hate implacable, the fanatic bacchanalian excesses with their dreary intervals of remorse and lassitude, which kept the other region in perpetual anarchy, and which,

constituted as we are, must trouble or dry up all the well-springs of enjoyment, whether in the hearts of individuals or in the bosom of families. We could have been at no loss, to have divined, from the history and state of such a world, the policy of its ruler. We should have recognised in that peculiar economy, by which every act whether of virtue or vice, made its performance still more virtuous or more vicious than before, a moral remuneration on the one hand and a moral penalty on the other—with an enhancement of all the consequences, whether good or evil, which flowed from each of them. We could not have mistaken the purposes and mind of the Deity—when we saw thus palpably, and through the demonstrations of experience, the ultimate effects of these respective processes; and, in this total diversity of character, with a like total diversity of condition, were made to perceive, that righteousness was its own eternal reward, and that wickedness was followed up, and that for ever, with the bitter fruit of its own ways.

11. Death so far intercepts the view of this result, that it is not here the object of sight or of experience. Still, however, it remains the object of our likely anticipation. The truth is, that the process which we are now contemplating, the process by which character is formed and strengthened and perpetuated, suggests one of the strongest arguments within the compass of the light of nature, for the immortality of the soul. In the system of the world we behold so many adaptations, not only between the faculties of sentient beings, and their counterpart objects in external nature; but between every historical progression in nature, and a fulfilment of corresponding interest or magnitude which it ultimately lands in—that we cannot believe of man's moral history, as if it terminated in death. More especially when we think of the virtuous character, how laboriously it is reared, and how slowly it advances to perfection; but, at length, how indefinite its capabilities of power and of enjoyment are, after this education of habits has been completed—it seems like the breach of a great and general analogy, if man is to be suddenly arrested on his way to the magnificent result, for which it might well be deemed that the whole of his life was but a preparation; having just reached the full capacity of an enjoyment, of which he had only been permitted, in this evanescent scene, a few brief and passing foretastes. It were like the infliction of a violence on the continuity of things, of which we behold no similar example, if a being so gifted were thus left to perish in the full maturity of his powers and moral acquisitions. The very eminence that he has won, we naturally look upon as the guarantee and the precursor of some great enlargement beyond it—warranting the hope, therefore, that Death but transforms without destroying him, or, that the present is only the embryo or rudimental state, the final developement of which is in another and future state of existence.

12. This is not the right place for a full exposition of this argument. We might only observe, that there is an evidence of man's

immortality, in the moral state and history of the bad upon earth, as well as of the good. The truth is, that nature's most vivid anticipations of a conscious futurity on the other side of death, are the forebodings of guilty fear, not the bright anticipations of confident and rejoicing hope. We speak not merely of the unredressed wrongs inflicted by the evil upon the righteous, and which seem to demand an afterplace of reparation and vengeance. Beside those unsettled questions between man and man, which death breaks off at the middle, and for the adjustment of which one feels as if it were the cry of eternal justice that there should be a reckoning afterwards—besides these, there is felt, more directly and vividly still, the sense of a yet unsettled controversy, between the sinner and the God whom he has offended. The notion of immortality is far more powerfully and habitually suggested by the perpetual hauntings or misgivings of this sort of undefined terror, by the dread of a coming penalty—rather than by the consciousness of merit, or of a yet unsatisfied claim to a well-earned reward. Nor is the argument at all lessened by that observed phenomenon in the history of guilt, the decay of conscience; a hebetude, if it may be so termed, of the moral sensibilities, which keeps pace with the growth of a man's wickedness, and, at times, becomes quite inveterate towards the termination of his mortal career. The very torpor and tranquillity of such a state, would only appear all the more emphatically to tell, that a day of account is yet to come, when, instead of rioting, as heretofore, in the impunity of a hardihood that shields him alike from reproach and fear, conscience will at length re-awaken to upbraid him for his misdoings; at once the assertor of its own cause, and the executioner of its own sentence. And even the most desperate in crime, do experience, at times, such gleams and resuscitations of moral light, as themselves feel to be the precursors of a revelation still more tremendous—when their own conscience, fully let loose upon them, shall, in the hands of an angry God, be a minister of fiercest vengeance. Certain it is, that, if death, instead of an entire annihilation, be but a removal to another and a different scene of existence, we see in this, when combined with the known laws and processes of the mind, the possibility, at least, of such a consummation. There is much in the business, and entertainments, and converse, and day-light of that urgent and obtruding world by which we are surrounded, to carry off the attention of the mind from its own guiltiness, and so, to suspend the agony, which when thrown back upon itself and dis severed from all its objects of gratification, will be felt, without mitigation and without respite. In the busy whirl of life, the mind, drawn upon in all directions, can find, outwardly and abroad, the relief of a constant diversion from the misery of its own internal processes. But a slight change in its locality or its circumstances, would deliver it up to the full burthen and agony of these; nor can we imagine a more intense and intolerable wretchedness, than that which would ensue, simply by rescinding

the connexion which obtains in this world between a depraved mind and its external means of gratification—when, forced inwardly on its own haunted tenement, it met with nothing there but revenge unsatiated, and raging appetites, that never rest from their unappeased fermentation; and withal, to this perpetual sense of want, a pungent and pervading sense of worthlessness. It is the constant testimony of criminals, that, in the horrors and the tedium of solitary imprisonment, they undergo the most appalling of all penalties—a penalty, therefore, made up of moral elements alone; as neither pain, nor hunger, nor sickness, necessarily forms any of its ingredients. It strikingly demonstrates the character of Him who so constructed our moral nature, that from the workings of its mechanism alone, there should be evolved a suffering so tremendous on the children of iniquity, insomuch that a sinner meets with sorest vengeance when simply left to the fruit of his own ways—whether by the death which carries his disembodied spirit to its Tartarus; or by a resurrection to another scene of existence, where, in full possession of his earthly habits and earthly passions, he is nevertheless doomed to everlasting separation from their present counterpart and earthly enjoyments.

13. There is a distinction sometimes made between the natural and arbitrary rewards of virtue, or between the natural and arbitrary punishments of vice. The arbitrary is exemplified in the enactments of human law; there in general being no natural or necessary connexion between the crimes which it denounces, and the penalties which it ordains for them—as between the fine, or the imprisonment, or the death, upon the one hand; and the act of violence, whether more or less outrageous, upon the other. The natural again is exemplified in the workings of the human constitution; there being a connexion, in necessity and nature, between the temper which prompted the act of violence, and the wretchedness which it inflicts on him who is the unhappy subject, in his own bosom, of its fierce and wrestless agitations. It is thus that not only is virtue termed its own reward, but vice its own greatest plague or self-tormentor. We have no information of the arbitrary rewards or punishments in a future state, but from revelation alone. But of the natural, we have only to suppose, that the existing constitution of man, and his existing habits, shall be borne with him to the land of eternity; and we may inform ourselves now of these, by the experience of our own felt and familiar nature. Our own experience can tell that the native delights of virtue, unaided by any high physical gratifications, and only if not disturbed by grievous physical annoyances, were enough of themselves to constitute an elysium of pure and perennial happiness: and again, that the native agonies of vice, unaided by any inflictions of physical suffering, and only if unalleviated by a perpetual round of physical enjoyments, were enough of themselves to constitute a dire and dreadful Pandemonium. They

are not judicially awarded, but result from the workings of that constitution which God hath given to us; and they speak as decisively the purpose and character of Him who is the author of that constitution—as would any code of jurisprudence proclaimed from the sanctuary of heaven, and which assigned to virtue on the one hand, the honours and rewards of a blissful immortality, to vice on the other, a place of anguish among the outcasts of a fiery condemnation.

CHAPTER IV.

On the General Adaptation of External Nature to the Moral Constitution of Man.

1. IT needs but a cursory observation of life to be made sensible, that man has not been endowed with a conscience, without, at the same time, being placed in a theatre which afforded the most abundant scope and occasion for its exercise. The truth is, that, in the multitude of fellow-beings by whom he is surrounded, and in the manifold variety of his social and family relations, there is a perpetual call on his sense of right and wrong—insomuch, that to the doings of every hour throughout his waking existence, one or other of these moral designations is applicable. It might have been stigmatized as the example of a mal-adjustment in the circumstances of our species, had man been provided with a waste feeling or a waste faculty, which remained dormant and unemployed from the want of counterpart objects that were suited to it. The wisdom of God admits of a glorious vindication against any such charge in the physical department of our nature, where the objective and subjective have been made so marvellously to harmonise with each other; there being, in the material creation, sights of infinitely varied loveliness, and sounds of as varied melody, and many thousand tastes and odours of exquisite gratification, and distinctions innumerable of touch and feeling, to meet the whole compass and diversity of the human senses—multiplying without end, both the notice that we receive from external things, and the enjoyments that we derive from them. And as little in the moral department of our nature, is any of its faculties, and more especially the great and master faculty of all, left to languish from the want of occupation. The whole of life, in fact, is crowded with opportunities for its employment—or, rather, instead of being represented as the subject of so many distinct and ever-recurring calls, conscience may well be represented as the constant guide and guardian of human life; and,

for the right discharge of this high office, as being kept on the alert perpetually. The creature on whom conscience hath laid the obligation of refraining from all mischief, and rendering to society all possible good, lives under a responsibility which never for a single moment is suspended. He may be said to possess a continuity of moral being; and morality whether of a good or evil hue, tinges the whole current of his history. It is of a thing of constancy as well as a thing of frequency—for, even when not carried forth into action, it is not dormant; but possesses the mind in the form of a cherished purpose or cherished principle, or, as the Romans expressed it, of a perpetual will either to that which is good or evil. But over and above this, the calls to action are innumerable. In the wants of others; in their powers of enjoyment; in their claims on our equity, our protection, or our kindness; in the various openings and walks of usefulness; in the services which even the humblest might render to those of their own family, or household, or country; in the application, of that comprehensive precept, to do good unto all men as we have opportunity—we behold a prodigious number and diversity of occasions for the exercise of moral principle. It is possible that the lessons of a school may not be arduous enough nor diversified enough for the capacity of a learner. But this cannot be affirmed of that school of discipline, alike arduous and unremitting, to which the great author of our being hath introduced us. Along with the moral capacity by which He hath endowed us, He hath provided a richly furnished gymnasium for its exercises and its trials—where we may earn, if not the triumphs of virtue, at least some delicious foretastes of that full and final blessedness for which the scholarship of human life, with its manifold engagements and duties, is so obviously fitted to prepare us.

2. But let us now briefly state the adaptation of external nature to the moral constitution of man, with a reference to that three-fold generality which we have already expounded. We have spoken of the supremacy of conscience, and of the inherent pleasures and pains of virtue and vice, and of the law and operation of habit—as forming three distinct arguments for the moral goodness of Him, who hath so constructed our nature, that by its workings alone, man should be so clearly and powerfully warned to a life of righteousness—should in the native and immediate joys of rectitude, earn so precious a reward—and, finally, should be led onward to such a state of character, in respect of its confirmed good or confirmed evil, as to afford one of the likeliest prognostications which nature offers to our view of an immortality beyond the grave, where we shall abundantly reap the consequence of our present doings, in either the happiness of established virtue or the utter wretchedness and woe of our then inveterate depravity. But hitherto we have viewed this nature of man, rather as an individual and insulated constitution, than as a mechanism actuated upon by any forces or influences from without.

It is in this latter aspect that we are henceforth to regard it; and now only it is that we enter on the proper theme of our volume, or that the adaptations of the objective to the subjective begin to open upon us.* It will still be recollected, however,* that in our view of external nature, we comprehend, not merely all that is external to the world of mind—for this would have restricted us to the consideration of those reciprocal actings which take place between mind and matter. We further comprehend all that is external to one individual mind, and therefore the other minds which are around it; and so we have appropriated, as forming a part of our legitimate subject, the actings and reactings that take place between man and man in society.

3. And first, in regard to the power and sensibility of conscience, there is a most important influence brought to bear on each individual possessor of this faculty from without, and by his fellow-men. It will help us to understand it aright, if we reflect on a felt and familiar experience of all men—even the effect of a very slight notice, often of a single word from one of our companions, to recall some past scene or transaction of our lives, which had long vanished from our remembrance; and would, but for this reawakening, have remained in deep oblivion to the end of our days. The phenomenon can easily be explained by the laws of suggestion. Our wonted trains of thought might never have conducted the mind to any thought or recollection of the event in question—whereas, on the occurrence of even a very partial intimation, all the associated circumstances come into vivid recognition; and we are transported back again to the departed realities of former years, that had lain extinct within us for so long a period, and might have been extinct for ever, if not lighted up again by an extraneous application. How many are the days since early boyhood, of which not one trace or vestige now abides upon the memory. Yet perhaps there is not one of these days, the history of which could not be recalled, by means of some such external or foreign help to the remembrance of it. Let us imagine, for example, that a daily companion had, unknown to us, kept a minute and statistical journal of all the events we personally shared in; and the likelihood is, that, if permitted to the perusal of this document, even after the lapse of half a lifetime, our memory would depone to many thousand events which had else escaped, into utter and irrecoverable forgetfulness. It is certainly remarkable, that, on some brief utterance by another, the stories of former days should suddenly reappear, as if in illumined characters, on the tablet from which they had so totally faded; that the mention of a single circumstance, if only the link of a train, should conjure to life again a whole host of sleeping recollections: And so, in each of our fellow-men, might we have a remembrancer, who can

* See Introductory Chapter, 1, 2, 3.

vivify our consciousness anew, respecting scenes and transactions of our former history which had long gone by; and which, after having vanished once from a solitary mind left to its own processes, would have vanished everlastingly.

4. It is thus, that, not only can one man make instant translation of his own memory; but on certain subjects, he can even make instant translation of his own intelligence into the mind of another. A shrewd discerner of the heart, when laying upon its heretofore unrevealed mysteries, makes mention of things which at the moment we feel to be novelties; but which, almost at the same moment, are felt and recognised by us as truths—and that, not because we receive them upon this authority, but on the independent view that ourselves have of their own evidence. His utterance, in fact, has evoked from the cell of their imprisonment, remembrances, which but for him, might never have been awakened; and which, when thus summoned into existence, are so many vouchers for the perfect wisdom and truth of what he tells. A thousand peculiarities of life and character, till then unnoticed, are no sooner heard by us, although for the first time in our lives, than they shine before the mind's eye, in the light of a satisfying demonstration. And the reason is, that the materials of their proof have been actually stored up within us, by the history and experience of former years, though in chambers of forgetfulness—whence, however, they are quickly and vividly called forth, as if with the power of a talisman, by the voice of him, who no sooner announces his proposition, than he suggests the by-gone recollections of our own which serve to confirm it. The pages of the novelist, or the preacher, or the moral essayist, though all of them should deal in statements alone, without the formal allegation of evidence, may be informed throughout with evidence, notwithstanding; and that, because each of them speaks to the consciousness of his readers, unlocking a treasury of latent recollections, which no sooner start again into being, than they become witnesses for the sagacity and admirable sense of him with whom all this luminous and satisfying converse is held. It is like the holding up of a mirror, or the response of an echo to a voice. What the author discovers, the reader promptly and presently discerns. The one utters new things; but that light of immediate manifestation in which the other beholds them, is struck out of old materials which himself too had long since appropriated, but laid up in a dormitory, where they might have slumbered for ever—had it not been for that voice which charmed them anew into life and consciousness. This is the only way in which the instant recognition of truths before unheard of and unknown can possibly be explained. It is because their evidence lies enveloped in the reminiscences of other days, which had long passed into oblivion; but are again presented to the notice of the mind by the power of association.

5. This is properly a case of intellectual rather than of moral

adaptation; and is only now adverted to for the purpose of illustration. For a decayed conscience is susceptible of like resuscitation with a decayed memory. In treating of the effects of habit, we briefly noticed* the gradual weakening of conscience, as the indulgences of vice were persisted in. Its remonstrances, however ineffectual, may, at the first, have had a part in that train of thought and feeling, which commences with a temptation, and is consummated in guilt; but in proportion to the frequency, wherewith the voice of conscience is hushed, or overborne, or refused entertainment by the mind, in that proportion does it lift a feebler and a fainter voice afterwards—till at length it may come to be unheard; and any suggestions from this faculty may either pass unheeded, or perhaps drop out of the train altogether. It is thus that many a foul or horrid immorality may come at length to be perpetrated without the sense or feeling of its enormity. Conscience, with the repeated stiflings it has undergone, may, as if on the eve of extinction, have ceased from its exercises. This moral insensibility forms, in truth, one main constituent in the hardihood of crime. The conscience is cradled into a state of stupefaction; and the criminal, now a desperado in guilt, may prosecute his secret depravities, with no relentings from within, and no other dread upon his spirit, than that of discovery by his fellow men.

6. And it is on the event of such discovery, that we meet with the phenomenon in question. When that guilt, to which he had himself become so profoundly insensible, is at length beheld in the light of other minds—it is then that the scales are made to fall from the eyes of the offender; and he, as if suddenly awoke from lethargy, stands aghast before the spectacle of his own worthlessness. It is not the shame of detection, nor the fear of its consequences, which forms the whole of this distress. These may aggravate the suffering; but they do not altogether compose it—for often besides, is there a resurrection of the moral sensibilities within the bosom of the unhappy criminal, as if relumed at the touch of sympathy, with the pronounced judgments and feelings of other men. When their unperverted and unwarped consciences, because free from the delusions which encompass his own, give forth a righteous sentence—they enlist his conscience upon their side, which then reasserts its power, and again speaks to him in a voice of thunder. When that continuous train between the first excitement of some guilty passion, and its final gratification, from which the suggestions of the moral faculty had been so carefully excluded, is thus arrested and broken—then does conscience, as if emancipated from a spell, at times recover from the infatuation which held it; and utter reprehaches of its own, more terrible to the sinner's heart, than all the execrations of general society. And whatever shall forcibly terminate the guilty

* See Chap. iii. 6 of this Section.

indulgence, may, by interrupting the accustomed series of thoughts and purposes and passions, also dissipate and put an end to the inveteracy of this moral or spiritual blindness. The confinement of a prison-house may do it. The confinement of a death-bed may do it. And accordingly, on these occasions, does conscience, after an interval it would seem, not of death but only of suspended animation, come forth with the might of an avenger, and make emphatic representation of her wrongs.

7. But this influence which we have attempted to exhibit in bold relief, by means of rare and strong exemplification, is in busy and perpetual operation throughout society—and that, more to prevent crime than to punish it; rather, to maintain the conscience in freshness and integrity, than to reanimate it from a state of decay, or to recall its aberrations. Indeed its restorative efficacy, though far more striking, is not so habitual, nor in the whole amount so salutary, as its counteractive efficacy. The truth is, that we cannot frequent the companionships of human life, without observing the constant circulation and reciprocal play of the moral judgments among men—with whom there is not a more favourite or familiar exercise, than that of discussing the conduct and pronouncing on the deserts of each other. It is thus that every individual, liable in his own case to be misled or blinded by the partialities of interest and passion, is placed under the observation and guardianship of his fellows—who, exempted from his personal or particular bias, give forth a righteous sentence and cause it to be heard. A pure moral light is by this means kept up in society, composed of men whose thoughts are ever employed in ‘accusing or else excusing one another’—so that every individual conscience receives an impulse and a direction from sympathy with the consciences around it. We are aware that the love of applause intervenes at this point as a distinct and auxiliary influence. But the primary influence is a moral one. Each man lives under a consciousness of the vigilant and discerning witnesses who are on every side of him; and his conscience, kept in accordance with theirs, acts both more powerfully and more purely, than if left to the decay and the self-deception of its own withering solitude. The lamp which might have waxed dim by itself, revives its fading lustre, by contact and communication with those which burn more brightly in other bosoms than its own; and this law of interchange between mind and mind, forms an important adaptation in the mechanism of human society.

8. But, to revert for a moment to the revival of conscience after that its sensibilities had become torpid for a season; and they are quickened anew, as if by sympathy, with the moral judgments of other men. This phenomenon of conscience seems to afford another glimpse or indication of futurity. It at least tells with what facility that Being, who hath all the resources of infinity at command, could, and that by an operation purely mental, inflict the vengeance of a

the most exquisite, on the children of disobedience. He only to re-open the fountains of memory and conscience; and this will of itself cause distillation within the soul of the waters of bitterness. And if in the voice of earthly remembrancers and earthly judges, we observe such a power of re-awakening—we might infer, not the possibility alone, but the extreme likelihood of a far more vivid re-awakening, when the offended lawgiver himself takes the judgment into His own hands. If the rebuke of human tongues and human eyes be of such force to revive the sleeping agony within us, what may we not feel, when the adverse sentence is pronounced against us from the throne of God, and in the midst of a universal theatre? If, in this our little day, the condemnation is felt to be insupportable, that twinkles upon us from the thousand secondary and subordinate lustres by which we are surrounded—what must it be, when He, by whose hand they have all been lighted up, turns towards us the strength of his own countenance; and, with His look of reprobation sends forth trouble and dismay over the hosts of the rebellious.*

9. But besides the pleasures and pains of conscience, there is in the very taste and feeling of moral qualities, a pleasure or a pain. This formed our second general argument in favour of God's righteous administration; and our mental constitution, even when viewed singly, furnishes sufficient materials on which to build it. But the argument is greatly strengthened and enhanced by the adaptation to that constitution of external nature, more especially as exemplified in the reciprocal influences which take place between mind and mind in society; for the effects of this adaptation is to multiply both the pleasures of virtue and the sufferings of vice. The first, the original pleasure, is that which is felt by the virtuous man himself; as, for example, by the benevolent, in the very sense and feeling of that kindness whereby his heart is actuated. The second is felt by him who is the object of this kindness—for merely in the conscious possession of another's good-will, there is a great and distinct enjoyment. And then the manifested kindness of the former awakens gratitude, in the bosom of the latter; and this, too, is a highly pleasurable emotion. And lastly, gratitude sends back a delicious incense to the benefactor who awakened it. By the purely mental interchange of these affections, there is generated a prodigious amount of happiness; and that, altogether independent of the gratifications which are yielded by the material gifts of liberality on the one hand, or by the material services of gratitude on the other. Insomuch, that we have only to imagine a reign of perfect virtue; and then, in spite of the physical ills which essentially and inevitably

* Dr. Abercromby, in his interesting work on the intellectual powers, states some remarkable cases of resuscitated and enlarged memory, which remind one of the explanation given by Mr. Coleridge of the opening of the books in the day of judgment. It is on the opening of the book of conscience that the sinner is made to feel the truth and righteousness of his condemnation.

attach to our condition, we should feel as if we had approximated very nearly to a state of perfect enjoyment among men—or, in other words, that the bliss of paradise would be almost fully realized upon earth, were but the moral graces and charities of paradise firmly established there, and in full operation. Let there be honest and universal good-will in every bosom, and this be responded to from all who are the objects of it by an honest gratitude back again; let kindness, in all its various effects and manifestations, pass and repass from one heart and countenance to another; let there be a universal courteousness in our streets, and let fidelity and affection and all the domestic virtues take up their secure and lasting abode in every family; let the succour and sympathy of a willing neighbourhood be ever in readiness to meet and to overpass all the want and wretchedness to which humanity is liable; let truth, and honour, and inviolable friendship between man and man, banish all treachery and injustice from the world; in the walks of merchandise, let an unflinching integrity on the one side, have the homage done to it of unbounded confidence on the other, insomuch, that each man reposing with conscious safety on the uprightness and attachment of his fellow, and withal rejoicing as much in the prosperity of an acquaintance, as he should in his own, there would come to be no place for the harassments and the heart-burnings of mutual suspicion or resentment or envy: who does not see, in the state of a society thus constituted and thus harmonised, the palpable evidence of a nature so framed, that the happiness of the world and the righteousness of the world kept pace the one with the other? And it is all important to remark of this happiness, that, in respect both to quality and amount, it mainly consists of moral elements—so that while every giver who feels as he ought, experiences a delight in the exercise of generosity which rewards him a hundred-fold for all its sacrifices; every receiver who feels as he ought, rejoices infinitely more in the sense of the benefactor's kindness, than in the physical gratification or fruit of the benefactor's liberality. It is saying much for the virtuousness of Him who hath so moulded and so organized the spirit of man, that, apart from sense and from all its satisfactions, but from the ethereal play of the good affections alone, the highest felicity of our nature should be generated; that, simply by the interchange of cordiality between man and man, and one benevolent emotion re-echoing to another, there should be yielded to human hearts, so much of the truth and substance of real enjoyment—so that did justice, and charity, and holiness, descend from heaven to earth, taking full and universal possession of our species, the happiness of heaven would be sure to descend along with them. Could any world be pointed out, where the universality and reign of vice effected the same state of blissful and secure enjoyment that virtue would in ours—we should infer that he was the patron and the friend of vice, who had dominion over it. But when assured, on

the experience we have of our actual nature, that in the world we occupy, a perfect morality would, but for certain physical calamities, be the harbinger of a perfect enjoyment—we regard this as an incontestable evidence for the moral goodness of our own actual Deity.

10. And in such an argument as ours, although the main beatitudes of virtue are of a moral and spiritual character, its subserviency to the physical enjoyments of life ought not to be overlooked, though, perhaps, too obvious to be dwelt upon. The most palpable of these subserviencies is the effect of benevolence in diffusing abundance among the needy, and so alleviating the ills of their destitution. This is so very patent as not to require being expatiated on. Yet we might notice here one important adaptation, connected with the exercise of this morality—realized but in part, so long as virtue has only a partial occupation in society; but destined, we hope, to receive its entire and beautiful accomplishment, when virtue shall have become universal. It is well known that certain collateral but very serious mischiefs attend the exercise of a profuse and capricious and indiscriminate charity; that it may, in fact, augment and aggravate the indigence which it tries to relieve, beside working a moral deterioration among the humbler classes, by ministering to the reckless improvidence of the dissipated and the idle; an operation alike injurious to the physical comfort of the one party, and to the moral comfort of the other. These effects are inevitable, so long as the indiscriminate benevolence of the rich meets with an indefinite selfishness and rapacity on the part of the poor. But this evil will be mitigated and at length done away, with the growth of principle among mankind; and more especially, when, instead of being confined to one of these classes, it is partitioned among both. Let the wealthy be as generous as they ought in their doings, and the poor be as moderate as they ought in their expectations and desires; and then will that problem, which has so baffled the politicians and economists of England, find its own spontaneous, while, at the same time, its best adjustment. Let an exuberant yet well directed liberality on the one side, come into encounter, instead of a sordid and insatiable appetency, with the recoil of delicacy and self-respect upon the other, and the noble independence of men who will work with their own hands rather than be burthensome; and then will the benefactions of the wealthy, and the wants of the indigent, not only meet but overpass. The willingness of the one party to give, will exceed the willingness of the other to receive; and an evil which threatens to rend society asunder, and which law in her attempts to remedy has only exasperated, will at length give way before the omnipotence of moral causes. This, as being one of many specimens, tells most significantly that man was made for virtue, or that this was the purpose of God in making him—when we find, that through no other medium than the morality of the people, can the sorest distempers of society

be healed. The impotence of human wisdom, and of every political expedient which this wisdom can devise for the well-being of a state, when virtue languishes among the people, is one of the strongest proofs which experience affords, that virtue was the design of our creation. And we know not how more emphatic demonstration can be given of a virtuous Deity, than when we find society to have been so constructed by His hands, that virtue forms the great alternative on which the secure or lasting prosperity of a commonwealth is hinged—so that for any aggregate of human beings to be right physically and right economically, it is the indispensable, while at the same time the all effectual condition, that they should be right morally.

11. Nothing can be more illustrative of the character of God, or more decisive of the question, whether His preference is for universal virtue or for universal vice in the world, than to consider the effect of each on the well-being of human society—even that society which He did Himself ordain, and whose mechanism is the contrivance of His own intellect, and the work of His own hands. It may not be easy to explain the origin of that moral derangement into which the species has actually fallen; but it affords no obscure or uncertain indication of what the species was principally made for, when we picture to ourselves the difference between a commonwealth of vice and a commonwealth of virtue. We have already said enough on the obvious connexion which obtains between the righteousness of a nation and the happiness of its families; and it were superfluous to dilate on the equally obvious connexion which obtains between a state of general depravity, and a state of general wretchedness and disorder. And the counterpart observation holds true, that, as the beatitudes of the one condition, so the sufferings of the other are chiefly made up of moral elements. If, in the former, there be a more precious and heartfelt enjoyment in the possession of another's kindness, than in all the material gifts and services to which that kindness has prompted him—so in the latter, may it often happen, that the agony arising from simple consciousness of another's malignity, will greatly exceed any physical hurt, whether in person or property, that we ever shall sustain from him. A loss that we suffer from the dishonesty of another is far more severely felt, than a ten-fold loss occasioned by accident or misfortune—or, in other words, we find the moral provocation to be greatly more pungent and intolerable than the physical calamity. So that beside the material damage, too palpable to be insisted on at any length, which vice and violence inflict upon society, there should be taken into account the soreness of spirit, the purely mental distress and disquietude which follow in their train—of which we have already seen, how much is engendered even in the workings of one individual mind; but susceptible of being inflamed to a degree indefinitely higher, by the reciprocal working of minds, all of them hating and all hateful to each other. In this mere antipathy of the heart, more especially

when aided by nearness and the opportunities of mutual expression, there are sensations of most exquisite bitterness. There is a wretchedness in the mere collision of hostile feelings themselves, though they should break not forth into overt-acts of hostility; in the simple demonstrations of malignity, apart from its doings; in the war but of words and looks and fierce gesticulations, though no violence should be inflicted on the one side or sustained upon the other. To make the aggressor in these purely mental conflicts intensely miserable, it is enough that he should experience within him the agitations and the fires of a resentful heart. To make the recipient intensely miserable, it is enough that he should be demoniacally glared upon by a resentful eye. Were this power which resides in the emotions by themselves sufficiently reflected on, it would evince how intimately connected, almost how identified, wickedness and wretchedness are with each other. To realize the miseries of a state of war, it is not necessary that there should be contests of personal strength. The mere contests of personal feeling will suffice. Let there be mutual rage and mutual revilings; let there be the pangs and the outcries of fierce exasperation; let there be the continual droppings of peevishness and discontent; let disdain meet with equal disdain; or even, instead of scorn from the lofty, let there be but the slights and the insults of contempt from men, who themselves are of the most contemptible; let there be haughty defiance, and spiteful derision, and the mortifications of affronted and irritated pride—in the tumults of such a scene, though tumults of the mind alone, there were enough to constitute a hell of assembled maniacs or of assembled malefactors. The very presence and operation of these passions would form their own sorest punishment. To have them perpetually in ourselves is to have a hell in the heart. To meet with them perpetually in others is to be compassed about with a society of fiends, to be beset with the miseries of a Pandemonium.

12. Whether we look then to the separate or the social constitution of humanity, we observe abundant evidence for the mind and meaning of the Deity, who both put together the elements of each individual nature, and the elements which enter into the composition of society. We cannot imagine a more decisive indication of His favour being on the side of moral good, and His displeasure against moral evil, than that, by the working of each of these constitutions, virtue and happiness on the one hand, vice and wretchedness on the other, should be so intimately and inseparably allied. Such sequences or laws of nature as these, speak as distinctly the character of him who established them, as any laws of jurisprudence would the character of the monarch by whom they were enacted. And to learn this lesson, we do not need to wait for the distant consequences of vice or virtue. We at once feel the distinction put upon them by the hand of the Almighty, in the instant sensations which He hath appended to each of them—implicated as their effects are with the very

fountain-head of moral being, and turning the hearts which they respectively occupy, into the seats either of wildest anarchy, or of serene and blissful enjoyment.

13. The law and operation of habit, as exemplified in one individual mind, formed the theme of our third general argument. The only adaptation which we shall notice to this part of our mental constitution in the frame-work of society, is that afforded by the changes which it undergoes in the flux of its successive generations—in virtue of which, the tender susceptibilities of childhood are placed under the influence of that ascendant seniority which precedes or goes before it. At first sight it may be thought of this peculiarity, that it tells equally in both directions—that is, either in the transmission and accumulation of vice, or in the transmission and accumulation of virtue in the world. But there is one circumstance of superiority in favour of the latter, which bids us look hopefully onward to the final prevalence of the good over the evil. We are aware of the virulence wherewith, in families, the crime and profligacy of a depraved parentage must operate on the habits of their offspring; and of the deadly poison which, in crowded cities, passes with quick descent from the older to the younger, along the links of youthful companionship; and even of those secret, though we trust rare and monstrous societies, which, in various countries and various ages, were held for the celebration of infernal orgies, for the initiation of the yet unknown or unpractised in the mysteries of vice. But after every deduction has been made for these, who does not see that the systematic and sustained effort, the wide and general enterprise, the combination of numbers in the face of day and with the sympathies of an approving public, give a prodigious balance on the side of moral education? The very selfishness of vice and expansiveness of virtue give rise to this difference between them—the one concentrated on its own personal enjoyments, and, with a few casual exceptions, rather heedless of the principles of others than set on any schemes or speculations of proselytism; the other, by its very nature, aspiring after the good of the whole species, and bent on the propagation of its own likeness, till righteousness and truth shall have become universal among men. Accordingly, all the ostensible countenance and exertion, in the cause of learning, whether by governments or associations, is on the side of virtue; while no man could dare to front the public eye, with a scheme of discipleship in the lessons whether of fraud or profligacy. The clear tendency then is to impress a right direction on the giant power of education; and when this is brought to bear, more systematically and generally than heretofore, on the pliant boyhood of the land—we behold, in the operation of habit, a guarantee for the progressive conquests, and at length the ultimate and universal triumph of good over evil in society. Our confidence in this result is greatly enhanced, when we witness the influence even of but one mind among the hundreds of

any given neighbourhood—if zealously and wisely directed to the object of moral and economical improvement. Let that most prolific of all philanthropy then be fully and fairly set on foot, which operates, by means of education, on the early germs of character; and we shall have the most effective of all agency engaged, for the production of the likeliest of all results. The law of habit, when looked to in the manageable ductility of its outset, presents a mighty opening for the production of a new era in the moral history of mankind; and the same law of habit, when looked to in the maturity of its fixed and final establishment, encourages the expectation of a permanent as well as universal reign of virtue in the world.

14. Even in the yet chaotic and rudimental state of the world, we can observe the powers and the likelihoods of such a consummation; and what gives an overbearing superiority to the chances on the side of virtue is, that parents, although the most sunken in depravity themselves, welcome the proposals, and receive with gratitude, the services of Christian or moral philanthropy in behalf of their families. However hopeless then of reformation among those whose vicious habits have become inveterate, it is well that there should be so wide and unobstructed an access to those, among whom the habits have yet to be formed. It is this which places education on such firm vantage-ground, if not for reclaiming the degeneracy of individuals, yet for reclaiming after the lapse of a few generations the degeneracy of the species; and, however abortive many of the schemes and enterprises in this highest walk of charity may hitherto have proved, yet the manifest and growing attention to the cause does open a brilliant moral perspective for the ages that are to come. The experience of what has been done locally by a few zealous individuals, warrants our most cheering anticipations of what may yet be done universally—when the powers of that simple but mighty instrument which they employ, if brought to bear on that most malleable of all subjects, the infancy of human existence, come to be understood, and put into busy operation over the whole length and breadth of the land. In the grievous defect of our national institutions, and the wretched abandonment of a people left to themselves, and who are permitted to live recklessly and at random as they list—we see enough to account both for the profligacy of our crowded cities, and for the sad demoralisation of our neglected provinces. But on the other hand we feel assured, that, in an efficient system of wise and well principled instruction, there are capabilities within our reach for a great and glorious revival. We might not know the reason, why, in the moral world, so many ages of darkness and depravity should have been permitted to pass by—any more than we know the reason, why, in the natural world the trees of a forest, instead of starting all at once into the full efflorescence and stateliness of their manhood, have to make their slow and laborious advancement to maturity, cradled in storms,

and alternately drooping or expanding with the vicissitudes of the seasons. But, though unable to scan all the cycles either of the moral or natural economy, yet may we recognise such influences at work, as when multiplied and developed to the uttermost, are abundantly capable of regenerating the world. One of the likeliest of these influences is the power of education—to the perfecting of which so many minds are earnestly directed at this moment: and for the general acceptance of which in society, we have a guarantee, in the strongest affections and fondest wishes of the fathers and mothers of families.

CHAPTER V.

On the special and subordinate Adaptations of external Nature to the moral Constitution of Man.

1. WE have hitherto confined our attention to certain great and simple phenomena of our moral nature, which, though affording a different sort of evidence for the being of God from the organic and complicated structures of the material world—yet, on the hypothesis of an existent Deity, are abundantly decisive of His preference for virtue over vice, and so of the righteousness of His own character. That he should have inserted a great master faculty in every human bosom, all whose decisions are on the side of justice, benevolence, and truth, and condemnatory of their opposites; that He should have inserted this conscience with such powers of instant retribution, in the triumphs of that complacency wherewith he so promptly rewards the good, and the horrors of that remorse wherewith He as promptly chastises the evil; that besides these, He should have so distinguished between virtue and vice,* as that the emotions and excesses of the former should all be pleasureable, and of the

* Butler, in Part I, Chapter 3d of his Analogy, makes the following admirable discrimination between actions themselves and that quality ascribed to them which we call virtuous or vicious.—“An action by which any natural passion is gratified, or fortune acquired, procures delight or advantage, abstracted from all consideration of the morality of such action, consequently the pleasure or advantage in this case is gained by the action itself, not by the morality, the virtuousness, or viciousness of it, though it be, perhaps, virtuous or vicious. Thus to say, such an action or course of behaviour, procured such pleasure or advantage, or brought on such inconvenience and pain, is quite a different thing from saying that such good or bad effect was owing to the virtue or vice of such action or behaviour. In one case, an action abstracted from all moral consideration, produced its effect. In the other case, for it will appear that there are such cases, the morality of the action, the action under a moral consideration, *i. e.* the virtuousness or viciousness of it, produced the effect.

latter painful to the taste of the inner man ; that He should have so ordained the human constitution, as that by the law of habit, virtuous and vicious lives, or series of acts having these respective moral qualities, should issue in the fixed and permanent results of virtuous and vicious characters—these form the important generalities of our moral nature : And while they obviously and immediately announce to us a present demonstration in favour of virtue ; they seem to indicate a preparation and progress towards a state of things, when, after that the moral education of the present life has been consummated, the great Ruler of men will manifest the eternal distinction which he puts between the good and the evil.

2. Now in these few simple sequences, however strongly and unequivocally they evince the character of a God already proved or already presupposed, we have not the same intense evidence for design, which is afforded by the distinct parts or the distinct principles of a very multifarious combination. Yet the constitution of man's moral nature is not defective in this evidence—though certainly neither so prolific nor so palpable in our mental, as in our anatomical system. Still, however, there is a mechanism in mind as well as body, with a diversity of principles, if not a diversity of parts, consisting of so many laws, grafted it may be on a simple and indivisible substance, yet yielding in the fact of their beneficial concurrence, no inconsiderable argument for the wisdom and goodness of Him who framed us. Nor does it matter, as we have already said, whether these are all of them original, or some of them, as the analysts of mind have laboured to manifest, only derivative laws in the human constitution. If the former, we have an evidence grounded on the beneficial conjunction of a greater number of independent laws. If the latter, we are reduced to fewer independent laws—but these all the more prolific of useful applications, each of which applications is grounded on a beneficial adaptation of some peculiar circumstances, in the operation of which it is, that the primary is transmuted into a secondary law.* But whether the one or the other, they exhibit phases of humanity distinct from any that we have yet been employed in contemplating ; a number of special affections, each characterised by its own name, and pointing to its own separate object, yet all of them performing an important subsidiary part, for the moral good both of the individual and of the species ; and presenting us, therefore, with the materials of additional evidence for a moral and beneficent design in the formation of our race.

3. When we look to the beauty which overspreads the face of

* And besides this, would it not bespeak a more comprehensive wisdom on the part of a human artificer, that by means of one device, or by the application of one principle, he effected not a few, but many distinct and beneficial purposes ; and does it not in like manner enhance the exhibition of divine skill in the workmanship of nature, when a single law is found to subserve a vast and manifold variety of important uses ?

nature, and the exquisite gratification which it ministers to the senses of man—we cannot doubt, either the taste for beauty which resides in the primeval mind that emanated all this gracefulness; or the benevolence that endowed man with a kindred taste, and so fitted him for a kindred enjoyment. This conclusion, however, like any moral conclusion we have yet come to, respecting the perfections or the purposes of God, is founded on generalities,—on the general amount of beauty in the world, and the delight wherewith men behold and admire it. Yet, beside this, we may draw a corroborative evidence for the same, from the machinery of certain special contrivances—as the construction of the calyx in plants, for the defence of the tender blossom previous to its expansion; and the apparatus for scattering seeds, whereby the earth is more fully invested with its mantle of rich and varied garniture. And notwithstanding the blight which has so obviously passed over the moral world, and defaced many of its original lineaments, while it has left the materialism of creation, the loveliness of its scenes and landscapes, in a great measure untouched—still we possess very much the same materials for a Natural Theology, in reasoning on the element of virtue, as in reasoning on the element of beauty. We have first those generalities of argument which are already expounded by us at sufficient length; and we have also the evidence, now to be unfolded, of certain special provisions for the preservation and growth of the immortal plant, in the study of which, we shall observe more of mechanism than we have yet contemplated; and more, therefore, of that peculiar argument for design, which lies in the adaptation of varied means, in the concurrence of distinct expedients, each helping the other onward to a certain beneficial consummation.

4. But we must here premise an observation extensively applicable in mental science. When recognising the obvious subserviency of some given feeling or principle in the mind to a beneficial result—we are apt to imagine that it was somehow or other, in the contemplation of this result, that the principle was generated; and that therefore, instead of a distinct and original part of the human constitution, it is but a derivative from an anterior process of thought or calculation on the part of man, in the act of reflecting on what was most for the good of himself, or the good of society. In this way man is conceived to be in some measure the creator of his own mental constitution; or, at least, there are certain parts of it regarded as secondary, and the formation of which is ascribed to the wisdom of man, which, if regarded as instinctive and primary, would have been directly ascribed to the wisdom of God. There are many writers, for example, on the origin and rights of property, who, instead of admitting what may be termed an instinct of appropriation, would hold the appropriating tendency to be the result of human intelligence, after experience had of the convenience and benefits of such an arrangement. Now on this subject, we may take a lesson from the physi-

cal constitution of man. It is indispensable to the preservation of our animal system, that food should be received at certain intervals into the stomach. Yet, notwithstanding all the strength which is ascribed to the principle of self-preservation, and all the veneration which is professed by the expounders of our nature for the wisdom and foresight of man—the author of our frame has not left this important interest merely to our care, or our consideration. He has not so trusted us to ourselves; He has inserted among the other affections and principles wherewith He has endowed us, the appetite of hunger—a strong and urgent and ever-recurring desire for food, which, it is most certain, stands wholly unconnected with any thought on our part, of its physical or posterior uses for the sustenance of the body; and from which it would appear, that we need to be not only reminded at proper intervals of this incumbent duty, but goaded on to it. Could the analysts of our nature have ascertained of hunger, that it was the product of man's reflection on the necessity of food, it might have been quoted as an instance of the care which man takes of himself. But it seems that he could not be thus confided, either with his own individual preservation, or with the preservation of his species; and so, for the security of both these objects, strong appetites had to be given him, which, incapable of being resolved into any higher principles, stand distinctly and unequivocally forth, as instances of the care that is taken of him by God.

5. Now this, though it does not prove, yet may prepare us to expect similar provisions in the constitution of our minds. Indeed the operose and complicated system, which the great Architect of nature hath devised for our bodies, carries in it a sort of warning to those, who, enamoured of the simplifications of theory, would labour to reduce all our mental phenomena to one or two principles. There is no warrant for this in the examples which Anatomy and Physiology, those sciences that have to do with the animal economy of man, have placed before our eyes. Now, though we admit not this as evidence for the actual complexity of man's moral economy—it may at least school away those prepossessions of the fancy or of the taste, that would lead us to resist or to dislike such evidence when offered. We hold it not unlikely that the same Being, who, to supplement the defects of human prudence, hath furnished us with distinct corporeal appetites, that might prompt us to operations, of the greatest subservient benefit of both to the individual and the species—might also, to supplement the defects of human wisdom and principle, have furnished us with distinct mental affections or desires, both for our own particular good and the good of society. If man could not be left to his own guidance, in matters which needed but the anticipation of a few hours; but to save him from the decay and the death which must have otherwise ensued, had so powerful a remembrancer and instigator given to him as the appetite of hunger—we ought not to marvel, should it be found that na-

ture, in endowing him mentally, hath presumed on his incapacity, either for wisely devising or for regularly acting, with a view to distant consequences, and amid the complicated relations of human society. It may, on the one hand, have inserted forces, when the mere consideration of good effects would not have impelled; or, on the other hand, may have inserted checks, when the mere consideration of evil effects would not have arrested. Yet so it is, that, because of the good that is thereby secured and of the evil that is thereby shunned—we are apt to imagine of some of the most useful principles of our nature, that they are, somehow, the product of human manufacture; the results of human intelligence, or of rapid processes of thought by man, sitting in judgment on the consequences of his actions, and wisely providing either for or against them. Now it is very true, that the anger, and the shame, and the emulation, and the parental affection, and the compassion, and the love of reputation, and the sense of property, and the conscience or moral sense—are so many forces of a mechanism, which if not thus furnished, and that too within certain proportions, would run into a disorder that might have proved destructive both of the individual and of the species. For reasons already hinted at, we hold it immaterial to the cause of natural theism, whether these constitutional propensities of the human mind are its original or its secondary laws; but, at all events, it is enough for any argument of ours, that they are not so generated by the wisdom of man, as to supersede the inference which we draw from them, in favour both of the wisdom and goodness of God.

6. The common definition given of anger, is an instance of the tendency on the part of philosophers, if not to derive, at least to connect the emotions of which we have been made susceptible with certain anterior or higher principles of our nature. Dr. Reid tells us that the proper object of resentment is an injury; and that as “no man can have the notion of injustice, without having the notion of justice,” then, “if resentment be natural to man, the notion of justice must be no less natural.”* And Dr. Brown defines anger to be “that emotion of instant displeasure, which arises from the feeling of injury done or the discovery of injury intended, or, in many cases, from the discovery of the mere omission of good offices to which we conceived ourselves entitled, though this very omission may, of itself, be regarded as a species of injury.” Now the sense of injury implies a sense of its opposite—a sense of justice, there-

* In glaring contradiction to this, is Dr. Reid’s own affirmation regarding the brutes. He says, “that conscience is peculiar to man, we see no vestige of it in the brute animals. It is one of those prerogatives by which we are raised above them.” But animals are most abundantly capable of anger—even of that which, by a very general definition, is said to be the emotion that is awakened by a sense of injury, which sense of injury must imply in it the sense of its opposite, even of justice, and so land us in the conclusion that brutes are capable of moral conception, or that they have a conscience.

fore, or the conception of a moral standard from which the injury that has awakened the resentment, is felt to be a deviation. But as nothing ought to form part of a definition, which is not indispensable to the thing defined, it would appear, as if, in the judgment of both these philosophers, all who were capable of anger must also have, to a certain degree, a capacity of moral judgment or moral feeling. The property of resenting a hurt inflicted upon ourselves, would, at this rate, argue, in all cases, a perception of what the moral and equitable adjustment would be between ourselves and others. Now, that these workings of a moral nature are essential to the feeling of anger, is an idea which admits of most obvious and decisive refutation—it being an emotion to which not only infants are competent, anterior to the first dawns of their moral nature; but even idiots, with whom this nature is obliterated, or still more the inferior animals who want it altogether. There must be a sense of annoyance to originate the feeling; but a sense of injury, implying, as it does, a power of moral judgment or sensibility, can be in no way indispensable to an emotion, exemplified in its utmost force and intensity by sentient creatures, in whom there cannot be detected even the first rudiments of a moral nature. Two dogs, when fighting for a bone, make as distinct and declared an exhibition of their anger, as two human beings when disputing about the boundary of their contiguous fields. The emotion flashes as unequivocally from any of the inferior, as it does from the only rational and moral species on the face of our globe; as in the vindictive glare of an infuriated bull, or of a lioness robbed of her whelps, and who as if making proclamation of her wrongs, gives forth her deep and reiterated cry to the echoes of the wilderness. It is an emotion, in fact, which seems coextensive, not only with moral, but with physical sensation. And, if any faith can be placed in the physiognomy, or the natural signs, by which irrational creatures represent what passes within them; this passion announces itself as vividly and discernibly in the outcries of mutual resentment which ring throughout the amplitudes of savage and solitary nature, as in the contests of civilized man.

7. The truth, then, seems to be, that the office of the moral faculty is, not to originate, but rather to confine and qualify and regulate this emotion. Anger, if we but study its history and actual exhibitions, will be found the primary and the natural response to a hurt or harm or annoyance of any sort inflicted on us by others; and, as such, may be quite expansive and unrestrained and open to excitation from all points of the compass—anterior to and apart from any consideration of its justice, or whether in the being who called it forth, there have been the purpose or not of violating our rights. Infants are fully capable of the feeling, long before they have a notion of equity, or of what is rightfully their own and rightfully another's. The anger of animals, too, is, in like manner, destitute of that moral ingredient, which

the definitions we have quoted suppose indispensable to the formation of it. And yet their emitted sounds have the very expression of fierceness, that we meet with so often among the fellows of our own species. The provocation, the resentment, the kindling glance of hostility, the gradual heightening of the wrath, its discharge in acts of mutual violence, and lastly, its glutted satisfaction in the flight and even the death of the adversary—these are all indicative of kindred workings within, that have their outward vent in a common and kindred physiognomy, between him who is styled the lord of the creation, and those beneath his feet, who are conceived to stand at a distance that scarcely admits of comparison in the phenomena of their nature. Even man, in the full growth of his rational and moral nature, will often experience the outbreaks of an anger merely physical; as, to state one instance out of the many, may be witnessed in the anger wreaked by him on the inferior animals, when, all unconscious of injury to him, they enter upon his fields, or damage the fruit of his labours. The object of a just resentment towards others, is the purposed injustice of others towards us; and, so far from purposing the injustice, animals have not even the faculty of conceiving it. The moral consideration, then, does not enter as a constituent part into all resentment. It is rather a superadded quality which designates a species of it. It is not the epithet which characterises all anger, but is limited to a certain kind of it. It may be as proper to say of one anger that it is just, and of another that justice or morality has had nothing to do with it—as it is to say of one blow by the hand that it has been rightfully awarded, and of another blow that such a moral characteristic is wholly inapplicable. Morality may at times characterise both the mental feeling, and the muscular performance; but it should be as little identified with the one as with the other. And however much analysts may have succeeded on other occasions, in reducing to sameness what appeared to be separate constituents of our nature, certain it is, that anger cannot thus be regarded as a resulting manufacture from any of its higher principles. It forms a distinct and original part of our constitution, of which morality, whenever it exists and has the predominance, might take the direction, without being at all essential to the presence or operation of it. So far from this, it is nowhere exhibited in greater vivacity and distinctness than by those creatures who possess but an animal, without so much as the germ, or the rudest elements of a moral nature.

8. Anger then is an emotion that may rage and tumultuate in a bosom into which one moral conception has never entered. For its excitement nothing more seems necessary than to thwart any desire however unreasonable, or to disappoint any one object which the heart may chance to be set upon. So far from a sense of justice being needful to originate this emotion—it is the man who, utterly devoid of justice, would monopolise to himself all that lies within the visible

horizon, who is most exposed to its visitation. He is the most vulnerable to wrath from every point of the vast circumference around him—who, conceiving the Universe to be made for himself alone, is most insensible to the rights and interests of other men. It is in fact because he is so unfurnished with the ideas of justice, that he is so unbridled in resentment. Justice views the world and all its interests as already partitioned among the various members of the human population, each occupying his own little domain; and, instead of permitting anger to expatiate at random over the universal face of things, justice would curb and overrule its ebullitions in the bosom of every individual, till a trespass was made within the limits of that territory which is properly and peculiarly his own. In other words, it is the office of this virtue, not to inspire anger, but to draw landmarks and limitations around it; and, so far from a high moral principle originating this propensity, it is but an animal propensity, restrained and kept within check and confinement at the bidding of principle.

9. The distinction between reflective and unreflective anger did not escape the notice of the sagacious Butler, as may be seen in the following passages of a sermon upon resentment.—“Resentment is of two kinds—hasty and sudden, or settled and deliberate. The former is called anger and often passion, which, though a general word, is frequently appropriated and confined to the particular feeling, sudden anger, as distinct from deliberate resentment malice and revenge.” “Sudden anger upon certain occasions is mere instinct, as merely so, as the disposition to close our eyes upon the apprehension of something falling into them, and no more necessarily implies any degree of reason. I say necessarily, for, to be sure, hasty as well as deliberate anger, may be occasioned by injury or contempt, in which cases reason suggests to our thoughts the injury and contempt which is the occasion of the emotion: But I am speaking of the former, only in so far as it is to be distinguished from the latter. The only way in which our reason and understanding can raise anger, is by representing to our mind an injustice or injury of some kind or other. Now momentary anger is frequently raised, not only without any rule, but without any reason; that is, without any appearance of injury as distinct from hurt or pain. It cannot, I suppose, be thought that this passion in infants and the lower species of animals, and which is often seen in man towards them, it cannot, I say, be imagined that these instances of this emotion are the effect of reason: no, they are occasioned by mere sensation and feeling. It is opposition, sudden hurt, violence which naturally excites this passion; and the real demerit or fault of him who offers that violence, or is the cause of that opposition or hurt, does not in many cases so much as come into thought.” “The reason and end for which man was made thus liable to this emotion, is that he might be better qualified to prevent, and likewise or perhaps chiefly to resist

and defeat sudden force, violence, and opposition, considered merely as such, and without regard to the fault or demerit of him who is the author of them; yet since violence may be considered in this other and further view, as implying fault, and since injury as distinct from harm may raise sudden anger, sudden anger may likewise accidentally serve to prevent or remedy such fault and injury. But considered as distinct from settled anger, it stands in our nature for self-defence, and not for the administration of justice. There are plainly cases, and in the uncultivated parts of the world, and where regular governments are not formed, they frequently happen, in which there is no time for considering, and yet to be passive is certain destruction, in which sudden resistance is the only security."—It is an exceeding good instance that Bishop Butler gives of the distinction between instinctive and what may be called rational anger, when he specifies the anger that we often feel towards the inferior animals. There is properly no injury done, where there is no injury intended. And he who is incapable of conceiving what an injury is, is not a rightful object for at least any moral resentment. But that there is what may be called a physical as well as a moral resentment, is quite palpable from the positive wrath which is felt when anything untoward or hurtful is done to us even by the irrational creatures. The men who use them as instruments of service often discharge the most outrageous wrath upon them—acting the part of ferocious tyrants towards these wretched victims of their cruelty. When a combat takes place between man and one of the inferior animals, there is a resentment felt by the former just as keen and persevering, as if it were between two human combatants. This makes it quite obvious that there may be anger without any sense of designed injury on the part of him who is the object of it. Even children, idiots, lunatics, might all be the objects of such resentment.

10. The final cause of this emotion in the inferior animals is abundantly obvious. It stimulates and ensures resistance to that violence, which, if not resisted, would often terminate in the destruction of its object. And it probably much oftener serves the purpose of prevention than of defence. The first demonstration of a violence to be offered on the one hand, when met by the preparation and the counter-menace of an incipient resentment on the other, not only repels the aggression after it has begun, but still more frequently, we believe, through the reaction and restraint of fear on the otherwise attacking party, prevents the aggression from being made. The stout and formidable antagonists eye each other with a sort of natural respect; and, as if by a common though tacit consent, wisely abstain on either side from molestation, and pass onward without a quarrel. It is thus that many a fierce contest is forborne, which, but for the operation of anger on the one side, and fear upon the other, would most certainly have been entered upon. And so by a system, or machinery of reciprocal checks and counteractives, and

where the mental affections too perform the part of essential forces, there is not that incessant warfare of extermination which might have depopulated the whole world. And here we might observe, that, in studying that balance of power and of preserving influences, which obtains even in a commonwealth of brutes, the uses of a mental are just as palpable as those of a material collocation. The anger which prompts to the resistance of aggression is as obviously inserted by the hand of a contriver, as are the horns or the bristles or any other defensive weapons wherewith the body of the animal is furnished. The fear which wings the flight of a pursued animal is as obviously intended for its safety, as is its muscular conformation or capacity for speed. The affection of a mother for her young points as intelligibly to a designer's care for the preservation of the species, as does that apparatus of nourishment wherewith nature hath endowed her. The mother's fondness supplies as distinct and powerful an argument as the mother's milk—or, in other words, a mental constitution might, as well as a physical constitution, be pregnant with the indications of a God.

11. But to return to the special affection of anger, with a reference more particularly to its working in our own species, where we have the advantage of nearer and distincter observation. We must be abundantly sensible of the pain which there is, not merely in the feeling of resentment, when it burns and festers within our own hearts, but also in being, the objects of another's resentment. They are not the effects only of his anger that we are afraid of; we are afraid of the anger itself, of but the looks and the words of angry violence, though we should be perfectly secure from all the deeds of violence. The simple displeasure of another is formidable, though no chastisement whatever shall follow upon it. We are so constituted, that we tremble before the frown of an offended countenance, and perhaps as readily as we would under the menace of an uplifted arm; and would often make as great a sacrifice to shun the moral discomfort of another's wrath, as to shun the physical infliction which his wrath might impel him to lay upon us. It is thus that where there is no strength for any physical infliction, still there may be a power of correction that amply makes up for it, in the rebuke of an indignant eye or an indignant voice. This goes far to repair the inequalities of muscular force among men; and forms indeed a most important mound of defence against the effervescence and the outbreaks of brute violence in society. It is incalculable how much we owe to, this influence for the peace and courteousness that obtain in every neighbourhood. The more patent view of anger is, that it is an instrument of defence against the aggressions of violence or injustice: and by which they are kept in check, from desolating, as they otherwise would, the face of society. But it not only operates as a corrective against the outrages that are actually made. It has a preventive operation also; and we are wholly un-

able to say, in how far the dread of its forth-breaking, serves to soften and to subdue human intercourse into those many thousand decencies of mutual forbearance and complaisance, by which it is gladdened and adorned. There is a recoil from anger in the heart of every man when directed against himself; and many who would disdain to make one sacrifice by which to appease it, after it had thrown down the gauntlet of hostility, will in fact make one continued sacrifice of their tone and manner and habit, that it may not be awakened out of its slumbers. It were difficult to compute how much we are indebted, for the blandness and amenity of human companionships, to the consciousness of so many sleeping fires, in readiness to blaze forth, at the touch or on the moment of any provocation being offered. We doubt not, that, in military and fashionable, and indeed in all society, it acts as a powerful restraint on everything that is offensive. The domineering insolence of those who, with the instrument of anger too, would hold society in bondage, is most effectively arrested, when met by an anger which throws back the fear upon themselves, and so quiets and composes all their violence. It is thus that a balance is maintained, without which human society might go into utter derangement; and without which too, even the animal creation might lose its stability and disappear. And there is a kind of moral power in the anger itself, that is separate from the animal or the physical strength which it puts into operation; and which invests with command, or at least provides with defensive armour those who would otherwise be the most helpless of our species—so that decrepid age or feeble womanhood has by the mere rebuke of an angry countenance made the stoutest heart to tremble before them. It is a moral force, by which the inequalities of muscular force are repaired; and while itself a firebrand and a destroyer, yet, by the very terror of its ravages, which it diffuses among all, were it to stalk abroad and at large over the world—does it contribute to uphold the pacific virtues among men.

12. When the anger of one individual in a household is the terror of the rest, then that individual may become the little despot of the establishment; and thus it is that often the feeblest of them all in muscular strength may wield a domestic tyranny by which the stoutest is overpowered. But when the anger of this one is fortunately met with the spirit and resolution of another, then, kept at bay with its own weapon, it is neutralized into a state of innocence. It is not necessary for the production of this effect, that the parties ever should have come to the extremity of an open and declared violence. If there be only a mutual consciousness of each other's energy of passion and purpose, then a mutual awe and mutual forbearance may be the result of it. And thus it is, that, by the operation of these reciprocal checks in a family, the peace and order of it may be securely upholden. We have witnessed how much a wayward and outrageous temper has been sweetened, by

the very presence in the same mansion, of one who could speak again, and would not succumb to any unreasonable violence. The violence is abated. And we cannot compute how much it is that the blandness and the mutual complaisance which obtain in society are due to the secret dread in which men stand of each other's irritation; or, in other words, little do we know to what extent, the smile and the courteousness and the urbanity of civilized life, that are in semblance so many expressions of human benevolence, may, really and substantially, be owing to the fears of human selfishness. Were this speculation pursued, it might lead to a very humiliating estimate indeed of the virtue of individuals—though we cannot but admire the wisdom of that economy, by which, even without virtue, individuals may be made, through the mutual action and reaction of their emotions, to form the materials of a society that can stand. Anger does in private life, what the terrors of the penal code do in the community at large. It acts with salutary influence, in a vast multiplicity of cases, which no law could possibly provide for; and where the chastisements of law, whether in their corrective or preventive influence, cannot reach. The good of a penal discipline in society extends far and wide beyond the degree in which it is actually inflicted; and many are the pacific habits of a neighbourhood, that might be ascribed, not to the pacific virtues of the men who compose it, but to the terror of those consequences which all men know would ensue upon their violation. And it is just so of anger, in the more frequent and retired intercourse of private life. The good which it does by the fear of its ebullitions is greater far than all which is done by the actual ebullitions themselves. But we cannot fail to perceive that the amount of service which is done *in this way* to the species at large, must all be regarded as a deduction from the amount of credit which is due to the individuals who belong to it. We have already remarked on the propensity of moralists to accredit the wisdom of man with effects, which, as being provided for not by any care or reflection of ours, but by the operation of constitutional instincts—are more properly and immediately to be ascribed to the wisdom of God. And in like manner, there is a propensity in moralists to accredit the wisdom of man with effects, which, as being provided for not by any consciousness or exercise of principle on our part, but by the operation still of constitutional instincts—are more properly and immediately to be ascribed to the goodness of God.*

* The following extract from Brown tends well to illustrate one of the final causes for the implantation of this principle in our constitution.—“What human wants required, that all-foreseeing Power, who is the guardian of our infirmities, has supplied to human weakness. There is a principle in our mind, which is to us like a constant protector, which may slumber, indeed, but which slumbers only at seasons when its vigilance would be useless, which awakes therefore, at the first appearance of unjust intention, and which becomes more watchful and more vigorous, in proportion to the violence of the attack which it has to dread.

13. There is another special affection which we feel more particularly induced to notice, from its palpable effect in restraining the excess of one of nature's strongest appetites. Its position in the mental system reminds one of the very obvious adaptation to each other of the antagonist muscles in anatomy. We allude to the operation of shame between the sexes, considered as a check or counteractive to the indulgence of passion between the sexes. The former is as clear an instance of moral, as the latter is of physical adaptation. And in their adjustment the one to the other, we observe the sort of exquisite balancing, which, perhaps more than anything else, indicates the wisdom and the hand of a master—as if when, in the execution of some very nice and difficult task, he is managing between contrary extremes, or is devising in just proportion for contrary interests. We might better comprehend the design of this strikingly peculiar mechanism, by imagining the two opposite instincts, that either of them was in excess, or either of them in defect. Did the constitutional modesty prevail to a certain conceivable extent—it might depopulate the world. Did the animal propensity preponderate, on the other hand—it might land the world in an anarchy of unblushing and universal licentiousness—to the entire breaking up of our present blissful economy, by which society is partitioned into separate families; and, with the interests of domestic life to provide for, and its affections continually to recreate the heart in the midst of anxieties and labours, mankind are kept in a state both of most useful activity and of greatest enjoyment. We cannot conceive a more skilful, we had almost said a more delicate or dexterous adjustment, than the one actually fixed upon—by which, in the first instance, through an appetency sufficiently strong the species is upholden; and, in the second instance, through the same appetency sufficiently restrained, those hallowed decencies of life are kept unviolated, which are so indispensable to all order and to all moral gracefulness among men. We have only to conceive the frightful aspect

What should we think of the providence of nature, if, when aggression was threatened against the weak and unarmed, at a distance from the aid of others, there were instantly and uniformly, by the intervention of some wonder-working power, to rush into the hand of the defenceless a sword or other weapon of defence? And yet this would be but a feeble assistance, if compared with that which we receive from the simple emotions which Heaven has caused to rush, as it were, into our mind for repelling every attack. What would be a sword in the trembling hand of the infirm, of the aged, of him whose pusillanimous spirit shrinks at the very appearance, not of danger merely, but even of the arms by the use of which danger might be averted, and to whom consequently, the very sword, which he scarcely knew how to grasp, would be an additional cause of terror, not an instrument of defence and safety? The instant anger which arises does more than many such weapons. It gives the spirit, which knows how to make a weapon of everything, or, which of itself does, without a weapon, what even a thunder-bolt would be powerless to do, in the shuddering grasp of the coward. When anger arises, fear is gone; there is no coward, for all are brave. Even bodily infirmity seems to yield to it, like the very infirmities of the mind. The old are, for the moment, young again; the weakest, vigorous." Lect. lxiii.

which society would put on, did unbridled licentiousness stalk at large as a destroyer, and rifle every home of those virtues which at once guard and adorn it. The actual and the beautiful result, when viewed in connexion with that moral force, by the insertion of which in our nature it is accomplished, strongly bespeaks a presiding intellect—which in framing the mechanism of the human mind, had respect to what was most beneficent and best for the mechanism of human society.

14. It is well that man is so much the creature of a constitution which is anterior to his own wisdom and his own will, and of circumstances which are also anterior to his wisdom and his will. It would have needed a far more comprehensive view than we are equal to, both of what was best for men in a community and for man as an individual, to have left a creature so short-sighted or of such brief and narrow survey, with the fixing either of his own principles of action or of his relation with the external world. That constitutional shame, that quick and trembling delicacy, a prompt and ever-present guardian, appearing as it does in very early childhood, is most assuredly not a result from any anticipation by us, either of future or distant consequences. Even the moral sense within us, does not speak so loudly or so distinctly the evil of this transgression, as it does of falsehood, or of injurious freedom with the property of a neighbour, or of personal violence. Other forces than those of human prudence or human principle seem to have been necessary, for resisting a most powerful and destructive fascination, which never is indulged, without deterioration to the whole structure of the moral character and constitution; and which, when once permitted to lord it over the habits, so often terminates in the cruel disruption of families, and the irretrievable ruin and disgrace of the offender. It is not by any prospective calculation of ours, that this natural modesty, acting as a strong precautionary check against evils which however tremendous, we are too heedless to reflect upon, has been established within us. It is directly implanted by one, who sees the end from the beginning; and so forms altogether a most palpable instance, in which we have reason to congratulate ourselves, that the well-being of man, instead of being abandoned to himself, has been placed so immediately under the management of better and higher hands.

15. There are many other special affections in our nature—the principal of which will fall to be noticed in succeeding chapters; and the interests to which they are respectively subservient form a natural ground of division, in our treatment of them. Certain of these affections stand related to the civil, and certain of them to the economic well-being of society; and each of these subserviencies will form the subject of a separate argument.

CHAPTER VI.

On those special Affections which conduce to the civil and political Well-being of Society.

1. THE first step towards the aggregation of men into a community, or the first departure from a state of perfect isolation, could that state ever have subsisted for a single day, is the patriarchal arrangement. No sooner indeed is the infant creature ushered into being, than it is met by the cares and the caresses of those who are around it, and who have either attended or welcomed its entry on this scene of existence—as if, in very proportion to the extremity of its utter helplessness, was the strength of that security which nature hath provided, in the workings of the human constitution, for the protection of its weakness and the supply of all its little wants. That there should be hands to receive and to manage this tender visitant, is not more obviously a benevolent adaptation, than that there should be hearts to sympathize with its cries of impotency or distress. The maternal affection is as express an instance of this as the maternal nourishment—nor is the inference at all weakened, by the attempts, even though they should be successful, of those who would demonstrate of this universal fondness of mothers, that, instead of an original instinct, it is but a derived or secondary law of our nature. Were that analysis as distinct and satisfactory as it is doubtful and obscure, which would resolve all mental phenomena into the single principle of association—still the argument would stand. A secondary law, if not the evidence of a distinct principle, requires at least distinct and peculiar circumstances for its development; and the right ordering of these for a beneficial result, is just as decisively the proof and the characteristic of a plan, as are the collocations of Anatomy. It might not have been necessary to endow matter with any new property for the preparation of a child's aliment in the breast of its mother—yet the framework of that very peculiar apparatus by which the milk is secreted, and the suckling's mouth provided with a duct of conveyance for the abstraction of it, is, in the many fitnesses of time and place and complicated arrangement, pregnant with the evidence of a designer's contrivance and a designer's care. And in like manner, though it should be established, that the affection of a mother for her young from the moment of their birth, instead of an independent principle in her nature, was the dependent product of remembrances and feelings which had accumulated during the period of gestation, and were at length fixed amidst the agonies of parturition, into the strongest of all her earthly regards—the argument for design is just as entire, though, instead of connecting it with the peculiarity of an original law, we connect it

with the peculiarity of those circumstances which favour the development of this maternal feeling, in the form of a secondary law.

There is an infinity of conceivable methods, by which the successive generations of men might have risen into being; and our argument is entire, if, out of these, that method has been selected, whereof the result is an intense affection on the part of mothers for their offspring. It matters not whether this universal propensity of theirs be a primary instinct of nature, or but a resulting habit which can be traced to the process which they have been actually made to undergo, or the circumstances in which they have actually been placed. The ordination of this process, the mandate for the assemblage and collocation of these circumstances, gives as distinct and decisive indication of an ordaining mind, as would the establishment of any peculiar law. Let it suffice once for all to have said this—for if in the prosecution of our inquiry, we stopped at every turn to entertain the question, whether each beneficial tendency on which we reasoned, were an original or only a secondary principle in nature—we should be constantly rushing uncalled into the mists of obscurity; and fastening upon our cause an element of doubt and weakness, which in no wise belongs to it.

2. The other affections which enter into the composition, or rather, form the cement of a family, are more obviously of a derivative, and less obviously of an instinctive character, than is that strong maternal affinity which meets so opportunely with the extreme helplessness of its objects, that but for the succour and sympathy of those whose delight it is to cherish and sustain them, would perish in the infancy of their being. However questionable the analysis might be, which would resolve the universal fondness of mothers for their young into something anterior—the paternal and brotherly and filial affections seem, on surer grounds, and which are accessible to observation, not to be original but originated feelings. Inquirers, according to their respective tastes and tendencies, have deviated on both sides of the evidence—that is, either to an excessive and hypothetical simplification of nature, or to an undue multiplication of her first principles. And certain it is, that when told of the mystic ties which bind together into a domestic community, as if by a sort of certain peculiar attraction, all of the same kindred and the same blood—we are reminded of those occult qualities, which, in the physics both of matter and of mind, afforded so much of entertainment, to the scholastics of a former age. But with the adjustment of this philosophy we properly have no concern. It matters not to our argument whether the result in question be due to the force of instincts or to the force of circumstances,—any more than whether in the physical system, a certain beneficial result may be ascribed to apt and peculiar laws, or to apt and peculiar collocations. In virtue of one or other or both of these causes, we behold the individuals of the species grouped together—or, as it may be otherwise expressed,

the aggregate mass of the species, broken asunder into distinct families, and generally living by themselves, each family under one common roof, but apart from all the rest in distinct habitations; while the members of every little commonwealth are so linked by certain affections, or by certain feelings of reciprocal obligation, that each member feels almost as intensely for the wants and sufferings of the rest as he would for his own, or labours as strenuously for the sustenance of all as he would for his own individual sustenance. There is very generally a union of hearts, and still oftener a union of hands, for the common interest and provision of the household.

3. The benefits of such an arrangement are too obvious to be enumerated. Even though the law of self-preservation had sufficed in those cases where the individual has adequate wisdom to devise, and adequate strength to provide for his own maintenance—of itself, it could not have availed, when this strength and this wisdom are wanting. It is in the bosom of families, and under the touch and impulse of family affections, that helpless infancy is nurtured into manhood, and helpless disease or age have the kindest and most effective succour afforded to them. Even when the strength for labour, instead of being confined to one, is shared among several of the household, there is often an incalculable benefit, in the very concert of their forces and community of their gains—so long, for example, as a brotherhood, yet advancing towards maturity, continue to live under the same roof, and to live under the direction of one authority, or by the movement of one will. We shall not expatiate, either on the enjoyment that might be had under such an economy, while it lasts, in the sweets of mutual affection; or minutely explain how, after the economy is dissolved, and the separate members betake themselves each to his own way in the world—the duties and the friendships of domestic life are not annihilated by this dispersion; but, under the powerful influence of a felt and acknowledged relationship, the affinities of kindred spread and multiply beyond their original precincts, to the vast increase of mutual sympathy and aid and good offices in general society. It will not, we suppose, be questioned—that a vastly greater amount of good is done by the instrumentality of others, and that the instrumentality itself is greatly more available, under the family system, to which we are prompted by the strong affections of nature, than if that system were dissolved. But the remarkable thing is, that these affections had to be provided, as so many impellent forces—guiding men onward to an arrangement the most prolific of advantage for the whole, but which no care or consideration of the general good would have led them to form. This provision for the wants of the social economy, is analogous to that, which we have already observed, for the wants of the animal economy. Neither of these interests was confided to any cold generality, whether of principle or prudence. In the one, the strong appetite of hunger supplements the deficiency of the rational principle of self-preservation. In the other, the strong family affec-

tions supplement the deficiency of the moral principle of general benevolence. Without the first, the requisite measures would not have been taken for the regular sustenance of the individual. Without the other, the requisite measures would not have been taken for the diffused sustenance of the community at large.

4. Such is the mechanism of human society, as it comes direct, from the hand of nature or of nature's God. But many have been the attempts of human wisdom to mend and to meddle with it. Cosmopolitanism, in particular, has endeavoured to substitute a sort of universal citizenship, in place of the family affections—regarding these as so many disturbing forces; because, operating only as incentives to a partial or particular benevolence, they divert the aim from that which should, it is contended, be the object of every enlightened philanthropist, the general and greatest good of the whole. It is thus that certain transcendental speculatists would cut asunder all the special affinities of our nature, in order that men, set at large from the ties and the duties of the domestic relationship, might be at liberty to prosecute a more magnificent and god-like career of virtue; and, in every single action, have respect, not to the well-being of the individual, but to the well-being of the species. And thus also, friendship and patriotism have been stigmatised, along with the family affections, as so many narrow-minded virtues, which, by their distracting influence, seduce men from that all-comprehensive virtue, whose constant study being the good of the world—a happy and regenerated world, it is the fond imagination of some, would be the result of its universal prevalence among men.

5. Fortunately, nature is too strong for this speculation, which, therefore, has only its full being, in the reveries or the pages of those who, in authorship, may well be termed the philosophical novelists of our race. But, beside the actual strength of those special propensities in the heart of man, which no generalization can overrule, there is an utter impotency in human means or human expedients, for carrying this hollow, this heartless generalization into effect. It is easy to erect into a moral axiom, the principle of greatest happiness; and then, on the strength of it, to denounce all the special affections, and propose the substitution of a universal affection in their place. But in prosecuting the object of this last affection, what specific and intelligible thing are they to do? How shall they go about it? What conventional scheme shall men fall upon next for obtaining the maximum of utility, after they have broken loose, each from his own little home, and have been emancipated from those intense regards, which worked so effectively and with such force of concentration there? It has never been clearly shown, how the glorious simplifications of those cosmopolites admit of being practically realised—whether by a combination, of which the chance is that all men might not agree upon it; or by each issuing quixotically forth of his own habitation, and labouring the best he may to realise the splendid conception by which he is fired and actuated.

And it does not occur to those who would thus labour to extirpate the special affections from our nature, that it is in the indulgence of them that all conceivable happiness lies; and that, in being bereft of them, we should be in truth bereft of all the means and materials of enjoyment. And there is the utmost difference in point of effect, as well as in point of feeling, between the strong love wherewith nature hath endued us for a few particular men, and the general love wherewith philosophers would inspire us for men in the abstract—the former philanthropy leading to a devoted and sustained habit of well directed exertion, for supplying the wants and multiplying the enjoyments of every separate household; the latter philanthropy, at once indefinite in its aim and intangible in its objects, overlooking every man just because charging itself with the oversight of all men. It is by a summation of particular utilities which each man, under the impulse of his own particular affections, contributes to the general good, that nature provides for the happiness of the world. But ambitious and aspiring man would take the charge of this happiness upon himself; and his first step would be to rid the heart of all its special affections—or, in other words, to unsettle the moral dynamics which nature hath established there, without any other moral dynamics, either of precise direction or of operative force, to establish in their room. After having paralysed all the ordinary principles of action, he would, in his newly modelled system of humanity, be able to set up no principle of action whatever. His wisdom, when thus opposed to the wisdom of nature, is utterly powerless to direct, however much, in those seasons of delusion when the merest nonentities and names find a temporary sway, it may be powerful to destroy.

Now there is nothing which so sets off the superior skill of one artist, as the utter failure of every other artist in his attempts to improve upon it. And so the failure of every philanthropic or political experiment which proceeds on the distrust of nature's strong and urgent and general affections, may be regarded as an impressive while experimental demonstration for the matchless wisdom of nature's God. The abortive enterprises of wild yet benevolent Utopianism; the impotent and hurtful schemes of artificial charity which so teem throughout the cities and parishes of our land; the pernicious legislation, which mars instead of medicates, whenever it intermeddles with the operations of a previous and better mechanism than its own—have all of them misgiven only because, instead of conforming to nature, they have tried to divert her from her courses, or have thwarted and traversed the strongest of her implanted tendencies. It is thus that every attempt for taking to pieces, whether totally or partially, the actual framework of society, and reconstructing it in a new way or on new principles—is altogether fruitless of good; and often fruitful of sorest evil both to the happiness and virtue of the commonwealth. That economy by which the family system would have been entirely broken up; and associated

men, living together in planned and regulated villages, would have laboured for the common good, and given up their children wholly undomesticated to a common education—could not have been carried into effect, without overbearing the parental affection, and other strong propensities of nature besides; and so, it was stifled in embryo, by the instant revolt of nature against it. That legislation, which, instead of overbearing, would but seduce nature from her principles, may subsist for generations—yet not without such distemper to society, as may at length amount to utter disorganization. And this is precisely the mischief which the pauperism of England hath inflicted on the habits of English families. It hath, by the most pernicious of all bribery, relaxed the ties and obligations of mutual relationship—exonerating parents on the one hand from the care and maintenance of their own offspring; and tempting children on the other to cast off the parents who gave them birth, and, instead of an asylum gladdened by the associations and sympathies of home, consigning them for the last closing years of weakness and decrepitude to the dreary imprisonment of a poor-house. Had the beautiful arrangements of nature not been disturbed, the relative affections which she herself has implanted would have been found strong enough, as in other countries, to have secured, through the means of a domestic economy alone, a provision both for young and old, in far greater unison with both the comfort and the virtue of families. The corrupt and demoralising system of England might well serve as a lesson to philanthropists and statesmen, of the hazard, nay of the positive and undoubted mischief, to which the best interests of humanity are exposed—when they traverse the processes of a better mechanism instituted by the wisdom of God, through the operation of another mechanism devised by a wisdom of their own.

7. And those family relations in which all men necessarily find themselves at the outset of life, serve to strengthen, if they do not originate certain other subsequent affections of wider operation, and which bear with most important effect on the state and security of a commonwealth. Each man's house may be regarded as a preparatory school, where he acquires in boyhood, those habits of subordination and dependence and reverence for superiors, by which he all the more readily conforms in after-life, to the useful gradations of rank and authority and wealth which obtain in the order of general society. We are aware of a cosmopolitism that would unsettle those principles which bind together the larger commonwealth of a state; and that too with still greater force and frequency, than it would unsettle those affections which bind together the little commonwealth of a family. It is easier to undermine in the hearts of subjects, their reverence for rank and station; than it is to dissolve the ties of parentage and brotherhood, or to denaturalize the hearts of children. Accordingly we may remember those seasons, when, in the form of what may be termed a moral epidemic, a certain spirit of lawlessness went abroad upon the land; and the minds of

men were set at liberty from the habit of that homage and respect, which in more pacific times, they, without pusillanimity and in spite of themselves, do render to family or fortune or office in society. We know that in specific instances, an adequate cause is too often given why men should cast off that veneration for rank by which they are naturally and habitually actuated—as, individually, when the prince or the noble, however elevated, may have disgraced himself by his tyranny or his vices; or, generally, when the patrician orders of the state may have entered into some guilty combination of force and fraud against the liberties of mankind, and outraged nature is called forth to a generous and wholesome reaction against the oppressors of their species. This is the revolt of one natural principle against the abuse of another. But the case is very different—when, instead of an hostility resting on practical grounds and justified by the abuses of a principle, there is a sort of theoretical yet withal virulent and inflamed hostility abroad in the land against the principle itself—when wealth and rank without having abused their privileges, are made *per se* the objects of a jealous and resentful malignity—when the people all reckless and agog, because the dupes of designing and industrious agitators, have been led to regard every man of affluence or station as their natural enemy—and when, with the bulk of the community in this attitude of stout and sullen defiance, authority is weakened and all the natural influences of rank and wealth are suspended. Now nature never gives more effectual demonstration of her wisdom, than by the mischief which ensues on the abjuration of her own principles; and never is the lesson thus held forth more palpable and convincing, than when respect for station and respect for office cease to be operating principles in society. We are abundantly sensible that both mighty possessions and the honours of an industrious ancestry may be disjoined from individual talent and character,—nay, that they may meet in the person of one so utterly weak or worthless, as that our reverence because of the adventitious circumstances in which he is placed, may be completely overborne by our contempt either for the imbecility or the moral turpitude by which he is deformed. But this is only the example of a contest between two principles, and of a victory by the superior over the inferior one. We are not, however, because of the inferiority of a principle to lose sight of its existence; or to betray such an imperfect discernment and analysis of the human mind, as to deny the reality of any one principle, because liable to be modified, or kept in check, or even for the time rendered altogether powerless, by the interposition and the conflict of another principle. If, on the one hand, rank may be so disjoined from righteousness as to forfeit all its claims to respect—on the other hand, to be convinced that these claims are the objects of a natural and universal acknowledgment, and have therefore a foundation in the actual constitution of human nature, let us only consider the

effect, when pre-eminent rank and pre-eminent or even but fair and ordinary righteousness, meet together in the person of the same individual. The effect of such a composition upon human feelings may well persuade us that, while a respect for righteousness admitted by all enters as one ingredient, a respect for rank has its distinct and substantive being also as another ingredient. We have the former ingredient by itself in a state of separation, and are therefore most sensible of its presence, when the object of contemplation is a virtuous man. But we are distinctly sensible to the superaddition of the latter ingredient, when, instead of a virtuous man, the object of contemplation is a virtuous monarch—though it becomes more palpable still, when it too is made to exist in a state of separation, which it does, when the monarch is neither hateful for his vices nor very estimable for his virtues; but stands forth in the average possession of those moralities and of that intellect which belong to common and every day humanity. Even such a monarch has only to appear among his subjects; and, in all ordinary times, he will be received with the greetings of an honest and heartfelt loyalty, while any unwonted progress through his dominions is sure to be met all over the land, by the acclamations of a generous enthusiasm. Even the sturdiest demagogue, if he come within the sphere of the royal presence, cannot resist the infection of that common sentiment by which all are actuated; but, as if struck with a moral impotency, he also, carried away by the fascination, is constrained to feel and to acknowledge its influence. Some there are, who might affect to despise human nature for such an exhibition, and indignantly exclaim that men are born to be slaves. But the truth is, that there is nothing prostrate, nothing pusillanimous in the emotion at all. Instead of this, it is a lofty chivalrous emotion, of which the most exalted spirits are the most susceptible, and which all might indulge without any forfeiture of their native or becoming dignity. We do not affirm of this respect either for the sovereignty of an empire, or for the chieftainship of a province—that it forms an original or constituent part of our nature. It is enough for our argument, if it be a universal result of the circumstances in every land, where such gradations of power and property are established. In a word, it is the doing of nature, and not of man; and if man, in the proud and presumptuous exercise of his own wisdom, shall lift his rebel hand against the wisdom of nature, and try to uproot this principle from human hearts—he will find that it cannot be accomplished, without tearing asunder one of the strongest of those ligaments, which bind together the component parts of human society into a harmonious and well-adjusted mechanism. And it is then that the wisdom which made nature, will demonstrate its vast superiority over the wisdom which would mend it—when the desperate experiment of the latter has been tried and found wanting. There are certain restraining forces (and reverence for rank and station is one of them)

which never so convincingly announce their own importance to the peace and stability of the commonwealth, as in those seasons of popular frenzy, when, for a time, they are slackened or suspended. For it is then that the vessel of the state, as if slipped from her moorings, drifts headlong among the surges of insurrectionary violence, till, as the effect of this great national effervescence, the land mourns over its ravaged fields and desolated families; when, after, the sweeping anarchy has blown over it, and the sore chastisement has been undergone, the now schooled and humbled people seek refuge anew in those very principles, which they had before traduced and discarded: And it will be fortunate if, when again settled down in the quietude of their much needed and much longed for repose, there be not too vigorous a reaction of those conservative influences, which, in the moment of their wantonness, they had flung so recklessly away—in virtue of which the whips may become scorpions, and the mild and well-balanced monarchy may become a grinding despotism.

8. Next to the wisdom which nature discovers in her implantation or developement of those affections, by which society is parcelled down into separate families; is the wisdom which she discovers in those other affections, by which the territory of a nation, and all upon it that admits of such a distribution, is likewise parcelled and broken off into separate properties. Both among the analysts of the human mind, and among metaphysical jurists and politicians, there is to be found much obscure and unsatisfactory speculation respecting those principles, whether elementary or complex, by which property is originated and by which property is upholden. We are not called to enter upon any subtle analysis for the purpose of ascertaining either what that is which gives birth to the possessory feeling on the part of an owner, or what that is which leads to such a universal recognition and respect for his rights in general society. It will be enough if we can evince that neither of these is a factitious product, devised by the wisdom or engendered by the authority of patriots and legislators, deliberating on what was best for the good and order of a community; but that both of them are the results of a prior wisdom, employed, not in framing a constitution for a state, but in framing a constitution for human nature. It will suffice to demonstrate this, if we can show, that, in very early childhood, there are germinated both a sense of property and a respect for the property of others; and that, long before the children have been made the subjects of any artificial training on the thing in question, or are at all capable of any anticipation, or even wish, respecting the public and collective well-being of the country at large. Just as the affection of a mother is altogether special, and terminates upon the infant, without any calculation as to the superiority of the family system over the speculative systems of the cosmopolites; and just as the appetite of hunger impels to the

use of food, without the least regard, for the time being, to the support or preservation of the animal economy—so, most assuredly, do the desires or notions of property, and even the principles by which it is limited, spring up in the breasts of children, without the slightest apprehension, on their part, of its vast importance to the social economy of the world. It is the provision, not of man, but of God.

9. That is my property, to the use and enjoyment of which I, without the permission of others, am free, in a manner that no other is; and it is mine and mine only, in as far as this use and enjoyment are limited to myself—and others, apart from any grant or permission by me, are restrained from the like use and the like enjoyment. Now the first tendency of a child, instead of regarding only certain things, as those to the use and enjoyment of which it alone is free, is to regard itself as alike free to the use and enjoyment of all things. We should say that it regards the whole of external nature as a vast common, but for this difference—that, instead of regarding nature as free to all, it rather regards it as free to itself alone. When others intermeddle with any one thing, in a way that suits not its fancy or pleasure, it resents and storms and exclaims like one bereft of its rights—so that, instead of regarding the universe as a common, it were more accurate to say, that it regarded the whole as its own property, or itself as the universal proprietor of all on which it may have cast a pleased or wishful eye. Whatever it grasps, it feels to be as much its own as it does the fingers which grasp it. And not only do its claims extend to all within its reach, but to all within the field of its vision—insomuch, that it will even stretch forth its hands to the moon in the firmament; and wreak its displeasure on the nurse, for not bringing the splendid bauble within its grasp. Instead then of saying, that, at this particular stage, it knows not how to appropriate anything, it were more accurate to say, that a universal tyrant and monopolist, it would claim and appropriate all things—exact from the whole of nature a subserviency to its caprices; and, the little despot of its establishment, giving forth its intimations and its mandates, with the expectation, and often with the real power and authority of instant obedience. We before said that its anger was coextensive with the capacity of sensation; and we now say that, whatever its rectified notion of property may be, it has the original notion of an unlimited range over which itself at least may expatiate, without let or contradiction—the self-constituted proprietor of a domain, wide as its desires, and on which none may interfere against its will, without awakening in its bosom, somewhat like the sense and feeling of an injurious molestation.*

* From what has been already said of resentment, it would appear, that the instinctive feeling of property, and instinctive anger are in a state of co-relation with each other. It is by offence being rendered to the former, that the latter is called forth. Anterior to a sense of justice, our disposition is to arrogate everything—and it is then that we are vulnerable to anger from all points of the compass. Let another meddle, to our annoyance, with anything whatever, at this early stage, and

10. And it is instructive to observe the process, by which this original notion of property is at length rectified into the subsequent notion, which obtains in general society. For this purpose we must inquire what the circumstances are which limit and determine that sense of property, which was quite general and unrestricted before, to certain special things, of which the child learns to feel that they are peculiarly its own—and that too, in a manner which distinguishes them from all other things, which are not so felt to be its own. The child was blind to any such distinction before—its first habit being to arrogate and monopolize all things; and the question is, what those circumstances are, which serve to signalize some things, to which, its feelings of property, now withdrawn from wide and boundless generality, are exclusively and specifically directed. It will make conclusively for our argument, if it shall appear, that this sense of property, even in its posterior and rectified form, is the work of nature, operating on the hearts of children; and not the work of man, devising, in the maturity of his political wisdom, such a regulated system of things, as might be best for the order and well-being of society.

11. This matter then might be illustrated by the contests of very young children, and by the manner in which these are adjusted to the acquiescence and satisfaction of them all. We might gather a lesson even from the quarrel which sometimes arises among them, about a matter so small as their right to the particular chairs of a room. If one for example, have just sat on a chair, though only for a few minutes, and then left it for a moment—it will feel itself injured, if, on returning, it shall find the chair in the possession of another occupier. The brief occupation which it has already had, gives it the feeling of a right to the continued occupation of it—insomuch, that, when kept out by an intruder, it has the sense of having been wrongously dispossessed. The particular chair of which it was for some time the occupier, is the object of a special possessory affection or feeling, which it attaches to no other chair; and by which it stands invested in its own imagination, as being, for the time, the only rightful occupier. This then may be regarded as a very early indication of that possessory feeling, which is afterwards of such extensive influence in the economy of social life—a feeling so strong, as often of itself to constitute a plea, not only sufficient in the apprehension of the claimant, but sufficient in the general sense of the community, for substantiating the right of many a proprietor.

12. But there is still another primitive ingredient which enters into this feeling of property; and we call it primitive, because ante-

we shall feel the very motion of anger which in a higher stage of moral and mental cultivation, is only called forth by its meddling with that which really and rightfully belongs to us. The sense of justice, instead of originating either the emotion of anger, or a sense of property, has the effect to limit and restrain both.

rior to the sanctions or the application of law. Let the child in addition to the plea that it had been the recent occupier of the chair in question, be able further to advance an argument for its right—that, with its own hands, it had just placed it beside the fire, and thereby given additional value to the occupation of it. This reason is both felt by the child itself, and will be admitted by other children even of a very tender age, as a strengthener of its claim. It exemplifies the second great principle on which the natural right of property rests—even that every man is proprietor of the fruit of his own labour; and that to whatever extent he may have impressed additional value on any given thing by the work of his own hands, to that extent, at least, he should be held the owner of it.

13. This then seems the way, in which the sense of his right to any given thing arises in the heart of the claimant; but something more must be said to account for the manner in which this right is deferred to by his companions. It accounts for the manner, in which the possessory feeling arises in the hearts of one and all of them, when similarly circumstanced; but it does not account for the manner in which this possessory feeling, in the heart of each, is respected by all his fellows—so that he is suffered to remain, in the secure and unmolested possession of that which he rightfully claims. The circumstances which originate the sense of property, serve to explain this one fact, the existence of a possessory feeling, in the heart of every individual who is actuated thereby. But the deference rendered to this feeling by any other individuals, is another and a distinct fact; and we must refer to a distinct principle from that of the mere sense of property, for the explanation of it. This new or distinct principle is a sense of equity—or that which prompts to likeness or equality, between the treatment which I should claim of others and my treatment of them; and in virtue of which, I should hold it unrighteous and unfair, if I disregarded or inflicted violence on the claim of another, which, in the same circumstances with him, I am conscious that I should have felt, and would have advanced for myself. Had I been the occupier of that chair, in like manner with the little claimant who is now insisting on the possession of it, I should have felt and claimed precisely as he is a doing. Still more, had I like him placed it beside the fire, I should have felt what he is now expressing—a still more distinct and decided right to it. If conscious of an identity of feeling between me and another in the same circumstances—then let my moral nature be so far evolved as to feel the force of this consideration; and, under the operation of a sense of equity, I shall defer the very claim, which I should myself have urged, had I been similarly placed. And it is marvellous, how soon the hearts of children discover a sensibility to this consideration, and how soon they are capable of becoming obedient to the power of it. It is, in fact, the principle on which a thousand contests of the nursery are settled, and many thousand more are

prevented; what else would be an incessant scramble of rival and ravenous cupidity, being mitigated and reduced to a very great, though unknown and undefinable extent, by the sense of justice coming into play. It is altogether worthy of remark, however, that the sense of property is anterior to the sense of justice, and comes from an anterior and distinct source in our nature. It is not justice which originates the proprietary feeling in the heart of an individual. It only arbitrates between the proprietary claims and feelings of different individuals—after these had previously arisen by the operation of other principles in the human constitution. Those writers on jurisprudence are sadly and inextricably puzzled, who imagine that justice presided over the first ordinations of property—utterly at a loss as they must be, to find out the principle that could guide her initial movements. Justice did not create property; but found it already created—her only office being to decide between the antecedent claims of one man and another: And, in the discharge of this office, she but compares the rights which each of them can allege, as founded either on the length of undisputed and undisposed of possession, or on the value they had impressed on the thing at issue by labour of their own. In other words, she bears respect to those two great primitive ingredients by which property is constituted, before that she had ever bestowed any attention, or given any award whatever regarding it. The matter may be illustrated by the peculiar relation in which each man stands to his own body, as being, in a certain view, the same with the peculiar relation in which each man stands to his own property. His sensitive feelings are hurt, by the infliction of a neighbour's violence upon the one; and his proprietary feelings are hurt by the encroachment of a neighbour's violence upon the other. But justice no more originated the proprietary, than it did the sensitive feelings—no more gave me the peculiar affection which I feel for the property I now occupy as my own, than it gave me my peculiar affection for the person which I now occupy as my own. Justice pronounces on the iniquity of any hurtful infliction by us on the person of another—seeing that such an infliction upon our own person, to which we stand similarly related, would be resented by ourselves. And Justice, in like manner, pronounces on the inequality or iniquity of any hurtful encroachment by us on the property of another—also seeing, that such an encroachment upon our own property, to which we stand similarly related, would be felt and resented by ourselves. Man feels one kind of pain, when the hand which belongs to him is struck by another; and he feels another kind of pain, when some article which it holds, and which he conceives to belong to him, is wrested by another from its grasp. But it was not justice which instituted either the animal economy in the one case, or the proprietary economy in the other. Justice found them both already instituted. Property is not the creation of justice; but is in truth a prior creation.

Justice did not form this material, or command it into being; but in the course of misunderstanding or controversy between man and man, property, a material pre-existent or already made, forms the subject of many of those questions which are put into her hands.

14. But, recurring to the juvenile controversy which we have already imagined for the purpose of illustration, there is still a third way in which we may conceive it to be conclusively and definitively settled. The parents may interpose their authority, and assign his own particular chair to each member of the household. The instant effect of such a decree, in fixing and distinguishing the respective properties in all time coming, has led, we believe, to a misconception regarding the real origin of property—in consequence of a certain obscure analogy between this act of parents or legislators over the family of a household, and a supposed act of rulers or legislators over the great family of a nation. Now, not only have the parents this advantage over the magistrates—that the property which they thus distribute is previously their own; but there is both a power of enforcement and a disposition to acquiescence within the limits of a home, which exist in an immeasurably weaker degree within the limits of a kingdom. Still, with all this superiority on the part of the household legislators, it would even be their wisdom, to conform their decree as much as possible to those natural principles and feelings of property, which had been in previous exercise among their children—to have respect, in fact, when making distribution of the chairs, both to their habits of previous occupation, and to the additional value which any of them may have impressed upon their favourite seats, by such little arts of upholstery or mechanics, as they are competent to practice. A wise domestic legislator would not thwart, but rather defer to the claims and expectations which nature had previously founded. And still more a national legislator or statesman, would evince his best wisdom, by, instead of traversing the constitution of property which nature had previously established, greatly deferring to that sense of a possessory right, which long and unquestioned occupation so universally gives; and greatly deferring to the principle, that, whatever the fruit of each man's labour may be, it rightfully, and therefore should legitimately belong to him. A government could, and at the termination of a revolutionary storm, often does, traverse these principles; but not without the excitement of a thousand heart-burnings, and so the establishment of a strong counteraction to its own authority in the heart of its dominions. It is the dictate of sound policy—that the natural, on the one hand, and the legal or political on the other, should quadrate as much as possible. And thus, instead of saying with Dr. Paley that property derived its constitution and being from the law of the land—we should say that law never exhibits a better understanding of her own place and functions, than when, founding on materials already provided, she feels that her wisest part is but to act

as an auxiliary, and to ratify that prior constitution which nature had put into her hands.

15. In this exposition which we have now attempted of the origin and rights of property, we are not insensible to the mighty use of law. By its power of enforcement, it perpetuates or defends from violation that existent order of things which itself had established, or, rather, which itself had ratified. Even though at its first ordinations it had contravened those natural principles which enter into the foundation of property, these very principles will, in time, re-appear in favour of the new system, and yield to it a firmer and a stronger support with every day of its continuance. Whatever fraud or force may have been concerned at the historical commencement of the present and actual distribution of property—the then new possessors have at length become old; and, under the canopy and protection of law, the natural rights have been superadded to the factitious or the political. Law has guaranteed to each proprietor a long continued occupation, till a strong and inveterate possessory feeling has taken root and arisen in every heart. And secure of this occupation, each may, in the course of years, have mixed up to an indefinite amount, the improvements of his own skill and labour with those estates—which, as the fruit whether of anarchy or of victorious invasion, had fallen into his hands. So that these first and second principles of natural jurisprudence, whatever violence may have been done to them at the overthrow of a former regime, are again fostered into all their original efficacy and strength during the continuance of a present one. Insomuch, that if, at the end of half a century, those outcasts of a great revolutionary hurricane, the descendants of a confiscated noblesse, were to rally and combine for the recovery of their ancient domains—they would be met in the encounter, not by the force of the existing government only, but by the outraged and resentful feelings of the existing proprietors, whose possessory and prescriptive rights, now nurtured into full and firm establishment, would, in addition to the sense of interest, enlist even the sense of justice upon their side. Apart from the physical, did we but compute the moral forces which enter into such a conflict, it will often be found that the superiority is in favour of the actual occupiers. Those feelings, on the one hand, which are associated with the recollection of a now departed ancestry and their violated rights, are found to be inoperative and feeble, when brought into comparison or collision with that strength which nature has annexed to the feelings of actual possession. Regarded as but a contest of sentiment alone, the disposition to recover is not so strong as the disposition to retain. The recollection that these were once my parental acres, though wrested from the hand of remote ancestors by anarchists and marauders, would not enlist so great or so practical a moral force on the aggressive side of a new warfare, as the reflection that these are now my possessed acres, which, though left but by immediate an-

cestors, I have been accustomed from infancy to call my own, would enlist on the side of the defensive. In the course of generations, those sedative influences, which tend to the preservation of the existing order, wax stronger and stronger; and those disturbing influences, which tend to the restoration of the ancient order, wax weaker and weaker—till man at last ceases to charge himself with a task so infinitely above his strength, as the adjustment of the quarrels and the accumulated wrongs of the centuries which have gone by. In other words, the constitution of law in regard to property, which is the work of man, may be so framed as to sanction, and, therefore, to encourage the enormities which have been perpetrated by the force of arms—while the constitution of the mind in regard to property, which is the work of nature, is so framed, as, with conservative virtue, to be altogether on the side of perpetuity and peace.

16. Had a legislator of supreme wisdom and armed with despotic power been free to establish the best scheme for augmenting the wealth and the comforts of human society—he could have devised nothing more effectual than that existing constitution of property, which obtains so generally throughout the world; and by which, each man, secure within the limits of his own special and recognised possession, might claim as being rightly and originally his, the fruit of all the labour which he may choose to expend upon it. But this was not left to the discovery of man, or to any ordinations of his consequent upon that discovery. He was not led to this arrangement by the experience of its consequences; but prompted to it by certain feelings, as much prior to that experience, as the appetite of hunger is prior to our experience of the use of food. In this matter, too, the wisdom of nature has anticipated the wisdom of man, by providing him with original principles of her own. Man was not left to find out the direction in which his benevolence might be most productive of enjoyment to others; but he has been irresistibly, and, as far as he is concerned, blindly impelled thereto by means of a family affection—which, concentrating his efforts on a certain few, has made them a hundred times more prolific of benefit to mankind than if all had been left to provide the best they may for the whole, without a precise or determinate impulse to any. And in like manner, man was not left to find out the direction in which his industry might be made most productive of the materials of enjoyment; but, with the efforts of each concentrated by means of a special possessory affection on a certain portion of the territory, the universal produce is incalculably greater than under a medley system of indifference, with every field alike open to all, and, therefore, alike unreclaimed from the wilderness—unless one man shall consent to labour it in seed time, although another should reap the fruit of his labour in the harvest. It is good that man was not trusted with the whole disentanglement of this chaos—but that a natural jurisprudence, founded on the constitution of the human mind, so far advances and

facilitates the task of that artificial jurisprudence, which frames the various codes or constitutions of human law. It is well that nature has connected with the past and actual possession of anything, so strong a sense of right to its continued possession; and that she has so powerfully backed this principle, by means of another as strongly and universally felt as the former, even that each man has a right to possess the fruit of his own industry. The human legislator has little more to do than to conform, or rather to promulgate and make known his determination to abide by principles already felt and recognised by all men. Wanting these, he could have fixed nothing, he could have perpetuated nothing. The legal constitution of every state, in its last and finished form, comes from the hand of man. But the great and natural principles, which secure for these constitutions the acceptance of whole communities—implanted in man from his birth, or at least evincing their presence and power in very early childhood—these are what bespeak the immediate hand of God.

17. But these principles, strongly conservative though they be, on the side of existing property do not at all times prevent a revolution—which is much more frequently, however, a revolution of power than of property. But when such is the degree of violence abroad in society, that even the latter is effected—this most assuredly, does not arise from any decay or intermission of the possessory feelings, that we have just been expounding; but from the force and fermentation of other causes which prevail in opposition to these, and in spite of them. And, after that such revolution has done its work and ejected the old dynasty of proprietors, the mischief to them may be as irrecoverable, as if their estates had been wrested from them, by an irruption from the waters of the ocean, by earthquake, or the sweeping resistless visitation of any other great physical calamity. The moral world has its epochs and its transitions as well as the natural, during which the ordinary laws are not suspended but only for the time overborne; but this does not hinder the recurrence and full reinstatement of these laws during the long eras of intermediate repose. And it is marvellous, with what certainty and speed, the conservative influences, of which we have treated, gather around a new system of things, with whatever violence, and even injustice, it may have been ushered into the world—inso much that, under the guardianship of the powers which be, those links of a natural jurisprudence, now irretrievably torn from the former, are at length transferred in all their wonted tenacity to the existing proprietors; riveting each of them to his own several property, and altogether establishing a present order of as great firmness and strength as ever belonged to the order which went before it, but which is now superseded and forgotten. It is well that nature hath annexed so potent a charm to actual possession; and a charm which strengthens with every year and day of its continuance. This may not efface the historical infamy of many

ancient usurpations. But the world cannot be kept in a state of perpetual effervescence; and now that the many thousand wrongs of years gone by, as well as the dead on whom they have been inflicted, are fading into deep oblivion—it is well for the repose of its living generations, that, in virtue of the strong possessory feelings which nature causes to arise in the hearts of existing proprietors and to be sympathized with by all other men, the possessors *de facto* have at length the homage done to them of possessors *de jure*; strong in their own consciousness of right, and strong in the recognition thereof by all their contemporaries.

18. But ere we have completed our views upon this subject, we must shortly dwell on a principle of very extensive application in morals; and which itself forms a striking example of a most beautiful and beneficent adaptation in the constitution of the human mind to the needs and the well-being of human society. It may be thus announced, briefly and generally:—however strong the special affections of our nature may be, yet, if along with them there be but a principle of equity in the mind, then, these affections, so far from concentrating our selfish regards upon their several objects to the disregard and injury of others, will but enhance our respect and our sympathy for the like affections in other men.

19. This may be illustrated, in the first instance, by the equity observed between man and man, in respect to the bodies which they wear—endowed, as we may suppose them to be, with equal, at least with like capacities of pain and suffering from external violence. To inflict that very pain upon another which I should resent or shrink from in agony, if inflicted upon myself—this to all sense of justice appears a very palpable iniquity. Let us now conceive then, that the sentient framework of each of the parties was made twice more sensitive, or twice more alive to pain and pungency of feeling than it actually is. In one view it may be said that each would become twice more selfish than before. Each would feel a double interest in warding off external violence from himself; and so be doubly more anxious for his own protection and safety. But, with the very same moral nature as ever, each, now aware of the increased sensibility, not merely in himself but in his fellows, would feel doubly restrained from putting forth upon him a hand of violence. So, grant him to have but a sense of equity—and, exactly in proportion as he became tender of himself, would he become tender of another also. If the now superior exquisiteness of his own frame afforded him a topic, on which, what may be called his selfishness would feel more intensely than before—the now superior exquisiteness of another's frame would, in like manner, afford a topic, on which his sense of justice would feel more intensely than before. It is even as when men of very acute sensibilities company together—each has, on that very account, a more delicate and refined consideration for the feelings of all the rest; and it is only

among men of tougher pellicle and rigid fibre, where coarseness and freedom prevail, because there coarseness and freedom are not felt to be offensive. Grant me but a sense of equity—and the very fineness of my sensations which weds me so much more to the care and the defence of my own person, would also, on the imagination of a similar fineness in a fellow-man, restrain me so much more from the putting forth of any violence upon his person. If I had any compassion at all, or any horror at the injustice of inflicting upon another, that which I should feel to be a cruelty, if inflicted upon myself—I would experience a greater recoil of sympathy from the blow that was directed to the surface of a recent wound upon another, precisely as I would feel a severer agony in a similar infliction upon myself. So, there is nothing in the quickness of my physical sensibilities, and by which I am rendered more alive to the care and the guardianship of my own person—there is nothing in this to blunt, far less to extinguish my sensibilities for other men. Nay, it may give a quicker moral delicacy to all the sympathies which I before felt for them. And especially, the more sensitive I am to the hurts and the annoyances which others bring upon my own person, the more scrupulous may I be of being in any way instrumental to the hurt or the annoyance of others.

20. The same holds true between man and man, not merely of the bodies which they wear, but of the families which belong to them. Each man, by nature, hath a strong affection for his own offspring—the young whom he hath reared, and with whom the daily habit of converse under the same roof, hath strengthened all the original affinities that subsisted between them. But one man, a parent, knows that another man, also a parent, is actuated by the very same appropriate sensibilities towards his offspring; and nought remains but to graft on these separate and special affections in each, a sympathy between one neighbour and another; that there might be a mutual respect for each other's family affections. After the matter is advanced thus far, we can be at no loss to perceive, that, in proportion to the strength of the parental affection with each, will be the strength of the fellow-feeling that each has with the affection of the other—insomuch that he who bears in his heart the greatest tenderness for his own offspring, would feel the greatest revolt against an act of severity towards the offspring of his friend. Now it is altogether so with the separate and original sense of property, in each of two neighbours, and a sense of justice grafted thereupon—even as a mutual neighbourlike sympathy may be grafted on the separate family affections. One man a proprietor, linked by many ties, with that which he hath possessed and been in the habitual use and management of for years, is perfectly conscious of the very same kind of affinity, between another man a proprietor and that which belongs to him. It is not the justice which so links him to his own property, any more than it is the sympathy with his neigh-

bour which has linked him to his own children. But the justice hath given him a respectful feeling for his neighbour's rights, even as the sympathy would give him a tenderness for his neighbour's offspring. And so far from there being aught in the strength of the appropriating principle that relaxes this deference to the rights of his neighbour, the second principle may in fact grow with the growth, and strengthen with the strength of the first one.

21. For the purpose of maintaining an equitable regard, or an equitable conduct to others—it is no more necessary that we should reduce or extirpate the special affections of our nature, than that, in order to make room for the love of another, we should discharge from the bosom all love of ourselves. So far from this, the affection we have for ourselves, or for those various objects which by the constitution of our nature we are formed to seek after and to delight in—is the measure of that dutiful regard which we owe to others, and of that dutiful respect which we owe to all their rights and all their interests. The very highest behest of social morality, while at the same time the most comprehensive of its rules, is that we should love our neighbour as we do ourselves. Love to our neighbour is the thing which this rule measures off—and love to ourselves is the thing which it measures by. These two then, the social and the selfish affections, instead of being as they too often are inversely, might under a virtuous regimen be directly proportional to each other. At all events the way to advance or magnify the one, is not surely to weaken or abridge the other. The strength of certain prior affections which by nature we do have, is the standard of certain posterior affections which morality tells that we ought to have. Morality neither planted these prior affections, nor does she enjoin us to extirpate them. They were inserted by the hand of nature for the most useful purposes; and morality, instead of demolishing her work, applies the rule and compass to it for the construction of her own.

22. It was not justice which presided over the original distribution of property. It was not she who assigned to each man his separate field, any more than it was she who assigned to each man his separate family. It was nature that did both, by investing with such power those anterior circumstances of habit and possession, which gave rise—first, to the special love that each man bears to his own children, and secondly, to the special love that each man bears to his own acres. Had there been no such processes beforehand, for thus isolating the parental regards of each on that certain household group which nature placed under his roof, and the proprietary regards of each on that certain local territory which history casts into his possession: or, had each man been so constituted, that, instead of certain children whom he felt to be his own, he was alike loose to them or susceptible of a like random and indiscriminate affection for any children; or, instead of certain lands

which he felt to be his own, he was alike loose to them or susceptible of a like tenacious adherence to any lands—had such been the rudimental chaos which nature put into the hands of man for the exercise of his matured faculties, neither his morality nor his wisdom would have enabled him to unravel it. But nature prepared for man an easier task ; and when justice arose to her work, she found a territory so far already partitioned, and each proprietor linked by a strong and separate tie of peculiar force to that part which he himself did occupy. She found this to be the land which one man went to possess and cultivate, and that to be the land which another man went to possess and cultivate—the destination, not originally, of justice, but of accident, which her office nevertheless is not to reverse, but to confirm. We hold it a beautiful part of our constitution, that, the firmer the tenacity wherewith the first man adheres to his own, once that justice takes her place among the other principles of his nature, the prompter will be his recognition of the second man's right to his own. If each man sat more loosely to his own portion, each would have viewed more loosely the right of his neighbour to the other portion. The sense of property, anterior to justice, exists in the hearts of all ; and the principle of justice, subsequent to property, does not extirpate these special affections, but only arbitrates between them. In proportion to the felt strength of the proprietary affection in the hearts of each, will be the strength of that deference which each, in so far as justice has the mastery over him, renders to the rights and the property of his neighbour. These are the principles of the *histoire raisonnée*, that has been more or less exemplified in all the countries of the world ; and which might still be exemplified in the appropriation of a desert island. If we had not had the prior and special determinations of nature, justice would have felt the work of appropriation to be an inextricable problem. If we had not had justice, with each man obeying only the impulse of his own affections and unobservant of the like affection of others, we should have been kept in a state of constant and interminable war. Under the guidance of nature and justice together, the whole earth might have been parcelled out, without conflict and without interference.

23. If a strong self-interest in one's person may not only be consistent with, but, by the aid of the moral sense, may be conducive to a proportionally strong principle of forbearance from all injury to the persons of other men—why may not the very same law be at work in regard to property as to person ? The fondness wherewith one nourishes and cherishes his own flesh, might, we have seen, enhance his sympathy and his sense of justice for that of other men ; and so, we affirm, might it be of the fondness wherewith one nourishes and cherishes his own field. The relation in which man stands to his own body, was anterior to the first dawnings of his moral nature ; and his instinctive sensibilities of pain and suffering,

when any violence is inflicted, were also anterior. But as his moral perceptions expand, and he considers others beside himself who are similarly related to their bodies—these very susceptibilities not only lead him to recoil from the violence that is offered to himself; but they lead him to refrain from the offering of violence to other men. They may have an air of selfishness at the first; yet so far from being obstacles in the way of justice, they are indispensable helps to it. And so may each man stand related to a property as well as to a person; and by ties that bind him to it, ere he thought of his neighbour's property at all—by instinctive affections, which operated previously to a sense of justice in his bosom; and yet which, so far from acting as a thwart upon his justice to others, gave additional impulse to all his observations of it. He feels what has passed within his own bosom, in reference to the field that he has possessed, and has laboured, and that has for a time been respected by society as his; and he is aware of the very same feeling in the breast of a neighbour in relation to another field; and in very proportion to the strength of his own feeling, does he defer to that of his fellow-men. It is at this point that the sense of justice begins to operate—not for the purpose of leading him to appropriate his own, for this he has already done; but for the purpose of leading him to respect the property of others. It was not justice which gave to either of them at the first that feeling of property, which each has in his own separate domain; any more than it was justice which gave to either of them that feeling of affection which each has for his own children. It is after, and not before these feelings are formed, that justice steps in with her golden rule, of not doing to others as we would not others to do unto us; and, all-conscious as we are of the dislike and resentment we should feel on the invasion of our property, it teaches to defer to a similar dislike and a similar resentment in other men. And, so far from this original and instinctive regard for his property which is my own serving at all to impair, when once the moral sense comes into play, it enhances my equitable regard for the property of others. It is just with me the proprietor, as it is with me the parent. My affection for my own family does not prompt me to appropriate the family of another; but it strengthens my sympathetic consideration for the tenderness and feeling of their own parent towards them. My affection for my own field does not incline me to seize upon that of another man; but it strengthens my equitable consideration for all the attachments and claims which its proprietor has upon it. In proportion to the strength of that instinct which binds me to my own offspring, is the sympathy I feel with the tenderness of other parents. In proportion to the strength of that instinct which binds me to my own property, is the sense of equity I feel towards the rights of all other proprietors. It was not justice which gave either the one instinct or the other; but justice teaches each man to bear re-

spect to that instinct in another, which he feels to be of powerful operation in his own bosom.

24. It is in virtue of my sentient nature that I am so painfully alive to the violence done upon my own body, as to recoil from the infliction of it upon myself. And it is in virtue of my moral nature, that, alive to the pain of other bodies than my own, I refrain from the infliction of it upon them. It is not justice which gives the sensations; but justice pronounces on the equal respect that is due to the sensations of all. Neither does justice give the sensations of property, but it finds them; and pronounces on the respect which each owes to the sensations of all the rest. It was not justice which gave the personal feeling; neither is it justice which gives the possessory feeling. Justice has nothing to do with the process by which this body came to be my own; and although now, perhaps, there is not a property, at least in the civilized world, which may not have passed into the hand of their actual possessor, by a series of purchases, over which justice had the direction—yet there was a time when it might have been said, that justice has had nothing to do with the process by which this garden came to be my own; and yet, then as well as now, it would have been the utterance of a true feeling, that he who touches this garden, touches the apple of mine eye. And it is as much the dictate of justice, that we shall respect the one sensation as the other. He, indeed, who has the greatest sensitiveness, whether about his own person or his own property, will with an equal principle of justice in his constitution, have the greatest sympathy, both for the personal and the proprietary rights of others. This view of it saves all the impracticable mysticism that has gathered around the speculations of those, who conceive of justice, as presiding over the first distributions of property; and so have fallen into the very common mistake, of trying to account for that which had been provided for by the wisdom of nature, as if it had been provided by the wisdom and the principle of man. At the first allocations of property, justice may have had no hand in them. They were altogether fortuitous. One man set himself down, perhaps on a better soil than his neighbour, and chalked out for himself a larger territory, at a time when there was none who interfered or who offered to share it with him; and so he came to as firm a possessory feeling in reference to his wider domain, as the other has in reference to his smaller. Our metaphysical jurists are sadly puzzled to account for the original inequalities of property, and for the practical acquiescence of all men in the actual and very unequal distribution of it—having recourse to an original social compact, and to other fictions alike visionary. But if there be truth in our theory, it is just as easy to explain, why the humble proprietor, would no more think of laying claim to certain acres of his rich neighbour's estate because it was larger than his own, than he would think of laying claim to certain children of his neighbour's family

because it was larger—or even of laying claim to certain parts of his neighbour's person because it was larger. He is sufficiently acquainted with his own nature to be aware, that, were the circumstances changed, he should feel precisely as his affluent neighbour does; and he respects the feeling accordingly. He knows that, if himself at the head of a larger property, he would have the same affection for all its fields^b that the actual proprietor has; and that, if at the head of a larger family, he would have the same affection with the actual parent for all its children. It is by making justice come in at the right place, that is, not prior to these strong affections of nature but posterior to them, that the perplexities of this inquiry are done away. The principle on which it arbitrates, is, not the comparative magnitude of the properties, but the relative feelings of each actual possessor towards each actual property; and if it find these in every instance, to be the very feelings which all men would have in the circumstances belonging to that instance—it attempts no new distribution, but gives its full sanction to the distribution which is already before it. This is the real origin and upholder of that conservative influence which binds together the rich and the poor in society; and thus it is that property is respected throughout all its gradations.

25. It is from the treatment of an original as if it were a derived affection, that the whole obscurity on this topic has arisen. It is quite as impossible to educe the possessory feeling from an anterior sense of justice, or from a respect for law—as it is to educe the parental feeling from a previous and comprehensive regard for the interests of humanity. There is no doubt that the general good is best promoted by the play of special family affections; but this is the work of nature, and not the work of man. And there is no doubt that the wealth and comfort of society are inconceivably augmented by those influences, which bind each individual nearly as much to his own property, as he is bound to his own offspring. But in the one case as well as the other, there were certain instinctive regards that came first, and the office of justice is altogether a subsequent one; not to put these regards into the breast of any, but to award the equal deference that is due to the regards of all—inso-much that the vast domain of one individual, perhaps transmitted to him from generation to generation, throughout the lengthened series of an ancestry, whose feet are now upon the earth, but whose top reaches the clouds and is there lost in distant and obscure antiquity—is, to the last inch of its margin, under a guardianship of justice as unviolable, as that which assures protection and ownership to the humble possessor of one solitary acre. The right of property is not the less deferred to, either because its divisions are unequal, or because its origin is unknown. And, even when history tells us that it is founded on some deed of iniquitous usurpation, there is a charm in the continued occupation, that prevails and has

the mastery over our most indignant remembrance of the villany of other days. It says much for the strength of the possessory feeling, that, even in less than half a century, it will, if legal claims are meanwhile forborne, cast into obliteration, all the deeds, and even all the delinquencies, which attach to the commencement of a property. At length the prescriptive right bears everything before it, as by the consuetude of English, by the use and wont of Scottish law. And therefore, once more, instead of saying, with Dr. Paley that it is the law of the land which constitutes the basis of property—the law exhibits her best wisdom, when she founds on the materials of that basis, which nature and the common sense of mankind have laid before her.

26. Dr. Thomas Brown, we hold to have been partly right and partly wrong upon this subject. He evinces a true discernment of what may be termed the pedigree of our feelings in regard to property, when he says and says admirably well—that, **“Justice is not what constitutes property; it is a virtue which presupposes property and respects it however constituted.”* And further, that—*“justice as a moral virtue is not the creation of property, but the conformity of our actions to those views of property, which vary in the various states of society.”* But it is not as he would affirm, it is not because obedience to a system of law, of which the evident tendency is to the public good, is the object of our moral regard—it is not this, which moralises, if we may be allowed such an application of the term, or rather, which constitutes the virtuousness of our respect to another man's property. This is the common mistake of those moralists, who would ascribe every useful direction or habitude of man to some previous and comprehensive view taken by himself of what is best for the good of the individual or the good of society; instead of regarding such habitude as the fruit of a special tendency impressed direct by the hand of nature, on a previous and comprehensive view taken by its author, and therefore bearing on it a palpable indication both of the goodness and the wisdom of nature's God—even as hunger is the involuntary result of man's physical constitution, and not of any care or consideration by man on the uses of food. The truth is—when, deferring to another's right of property, we do not think of the public good in the matter at all. But we are glad, in the first instance, each to possess and to use and to improve all that we are able to do without molestation, whether that freedom from molestation has been secured to us by law or by the mere circumstances of our state; and, in virtue of principles, not resulting from anticipations of the wisdom or any views of general philanthropy, (because developed in early childhood and long before we are capable of being either philanthropists or legislators) we feel a strong link of ownership with that

* Lecture lxxxiii.

which we have thus possessed and used, and on which we have bestowed our improvements; and we are aware that another man, in similar relation with another property, will feel towards it in like manner; and a sense of justice, or its still more significant and instructive name, of equity, suggests this equality between me and him—that, in the same manner as I would regard his encroachment on myself as injurious, so it were alike injurious, in me to make a similar encroachment upon my neighbour.

27. We have expatiated thus long on the origin and rights of property—because of all subjects, it is the one, regarding which our writers on jurisprudence have sent forth the greatest amount of doubtful and unsatisfactory metaphysics. They labour and are in great perplexity to explain even the rise of the feeling or desire that is in the mind regarding it. They reason, as if the very conception of property was that, which could not have entered into the heart of man without a previous sense of justice. In this we hold them to have antedated matters wrong. The conception of property is aboriginal; and the office of justice is not to put it into any man's head; but to arbitrate among the rival feelings of cupidity, or the arrogant and overpassing claims that are apt to get into all men's heads—not to initiate man into the notion of property; but, in fact, to limit and restrain his notion of it—not to teach the creatures who at first conceive themselves to have nothing, what that is which they might call their own; but to teach the creatures whose first and earliest tendency is to call everything their own, what that is which they must refrain from and concede to others. When justice rises to authority among men, her office is, not to wed each individual by the link of property to that which he formerly thought it was not competent for him to use or to possess; but it is to divorce each individual from that, which it is not rightly competent for him to use or to possess—and thus restrict each to his own rightful portion. Its office in fact is restrictive, not dispensatory. The use of it is, not to give the first notion of property to those who were destitute of it, but to limit and restrain the notion with those among whom it is apt to exist in a state of overflow. The use of law, in short, the great expounder and enforcer of property, is not to instruct the men, who but for her lessons would appropriate none; but it is to restrain the men who, but for her checks and prohibitions, would monopolize all.

28. Such then seems to have been the purpose of nature in so framing our mental constitution, that we not only appropriate from the first; but feel, each, such a power in those circumstances, which serve to limit the appropriation of every one man and to distinguish them from those of others—that all, as if with common and practical consent, sit side by side together, without conflict and without interference, on their own respective portions, however unequal, of the territory in which they are placed. On the uses, the indispen-

sable uses of such an arrangement, we need not expatiate.* The hundred-fold superiority, in the amount of produce for the subsistence of human beings, which an appropriated country has over an equal extent of a like fertile but unappropriated, and, therefore, unreclaimed wilderness, is too obvious to be explained. It may be stated however; and when an economy so beneficial, without which even a few stragglers of our race could not be supported in comfort; and a large human family, though many times inferior to that which now peoples our globe, could not be supported at all—when the effect of this economy, in multiplying to a degree inconceivable the aliment of human bodies, is viewed in connexion with those prior tendencies of the human mind which gave it birth, we cannot but regard the whole as an instance, and one of the strongest which it is possible to allege, of the adaptation of external nature to that mental constitution, wherewith the Author of nature hath endowed us.

29. In connexion with this part of our subject, there is one especial adaptation; the statement of which we more willingly bring forward, that, besides being highly important in itself, it forms an instance of adaptation in the pure and limited sense of the term†—even the influence of a circumstance strictly material on the state of the moral world, in all the civilized, and indeed in all the appropriated countries on the face of the earth. We advert to the actual fertility of the land, and to the circumstances purely physical by which the degree or measure of that fertility is determined. It has been well stated by some of the expounders of geological science, that, while the vegetable mould on the earth's surface is subject to perpetual waste, from the action both of the winds and of the waters, either blowing it away in dust, or washing it down in rivers to the ocean—the loss thus sustained, is nevertheless perpetually re-

* “The effect (of the abolition of property) would be as instant as inevitable. The cultivation of the fields would be abandoned. The population would be broken up into straggling bands—each prowling in quest of a share in the remaining subsistence for themselves; and in the mutual contests of rapacity, they would anticipate, by deaths of violence, those still crueller deaths that would ensue, in the fearful destitution which awaited them. Yet many would be left whom the sword had spared, but whom famine would not spare—that overwhelming calamity under which a whole nation might ultimately disappear. But a few miserable survivors would dispute the spontaneous fruits of the earth with the beasts of the field, who now multiplied and overran that land which had been desolated of its people. And so by a series, every step of which was marked with increasing wretchedness, the transition would at length be made to a thinly scattered tribe of hunters, on what before had been a peopled territory of industrious and cultivated men. Thus, on the abolition of a single law, the fairest and most civilized region of the globe, which at present sustains its millions of families, out of a fertility that now waves over its cultivated, because its appropriated acres, would, on the simple tie of appropriation being broken, lapse in a very few years into a frightful solitude, or, if not bereft of humanity altogether, would at last become as desolate and dreary as a North American wilderness.”—Political Economy in connexion with the Moral State and Moral Prospects of Society.

† See the first paragraphs of the introductory chapter.

paired by the operation of the same material agents on the uplands of the territory—whence the dust and the debris, produced by a disintegration that is constantly going on even in the hardest rocks, is either strewed by the atmosphere, or carried down in an enriching sediment by mountain streams to the lands which are beneath them. It has been rightly argued, as the evidence and example of a benevolent design, that the opposite causes of consumption and of supply are so adjusted to each other, as to have ensured the perpetuity of our soils.* But even though these counteracting forces had been somewhat differently balanced; though the wasting operation had remained as active and as powerful, while a more difficult pulverization of the rocks had made the restorative operation slower and feebler than before—still we might have had our permanent or stationary soils, but only all of less fertility than that in which we now find them. A somewhat different constitution of the rocks; or a somewhat altered proportion in the forces of that machinery which is brought to bear upon them—in the cohesion that withstands, or in the impulse and the atmospherical depositions and the grinding frosts and the undermining torrents that separate and carry off the materials—a slight change in one or all of these causes, might have let down each of the various soils on the face of the world to a lower point in the scale of productiveness than at present belongs to them. And when we think of the mighty bearing which the determination of this single element has on the state and interests of

* “It is highly interesting to trace up, in this manner, the action of causes with which we are familiar, to the production of effects, which at first seem to require the introduction of unknown and extraordinary powers; and it is no less interesting to observe, how skilfully nature has balanced the action of all the minute causes of waste and rendered them conducive to the general good. Of this we have a most remarkable instance, in the provision made for preserving the soil, or the coat of vegetable mould, spread out over the surface of the earth. This coat, as it consists of loose materials, is easily washed away by the rains, and is continually carried down by the rivers into the sea. This effect is visible to every one; the earth is removed not only in the form of sand and gravel, but its finer particles suspended in the waters, tinge those of some rivers continually, and those of all occasionally, that is, when they are flooded or swollen with rains. The quantity of earth thus carried down, varies according to circumstances; it has been computed in some instances, that the water of a river in a flood, contains earthy matter suspended in it, amounting to more than the two hundred and fiftieth part of its own bulk. The soil therefore, is continually diminished, its parts being delivered from higher to lower levels, and finally delivered into the sea. But it is a fact, that the soil, notwithstanding, remains the same in quantity, or at least nearly the same, and must have done so, ever since the earth was the receptacle of animal or vegetable life. The soil therefore is augmented from other causes, just as much, at an average, as it is diminished by those now mentioned; and this augmentation evidently can proceed from nothing but the constant and slow disintegration of the rocks. In the permanence, therefore, of a coat of vegetable mould on the surface of the earth, we have a demonstrative proof of the continual destruction of the rocks; and cannot but admire the skill, with which the powers of the many chemical and mechanical agents employed in this complicated work, are so adjusted, as to make the supply and the waste of the soil exactly equal to one another.”—Playfair’s Illustrations of the Huttonian Theory. Section iii. Art. 13.

human society, we cannot resist the conclusion that, depending as it does on so many influences, there has, in the assortment of these, been a studied adaptation of the material and the mental worlds to each other. For only let us consider the effect, had the fertility been brought so low, as that on the best of soils, the produce extracted by the most strenuous efforts of human toil, could no more than repay the cultivation bestowed on them—or that the food, thus laboriously raised, would barely suffice for the maintenance of the labourers. It is obvious that a fertility beneath this point would have kept the whole earth in a state of perpetual barrenness and desolation—when, though performing as now its astronomical circuit in the heavens, it would have been a planet bereft of life, or at least unfit for the abode and sustenance of the rational generations by whom it is at present occupied. But even with a fertility at this point, although a race of men might have been upholden, the tenure by which each man held his existence behoved to have been a life of unremitting drudgery; and we should have beheld the whole species engaged in a constant struggle of penury and pain for the supply of their animal necessities. And it is because of a fertility above this point, the actual fertility of vast portions of land in most countries of the earth—that many and extensive are the soils which yield a large surplus produce, over and above the maintenance of all, who are engaged, whether directly or indirectly, in the work of their cultivation. The strength of the possessory feelings on the one hand, giving rise to possessory rights recognised and acquiesced in by all men; these rights investing a single individual with the ownership of lands, that yield on the other hand a surplus produce, over which he has the uncontrolled disposal—make up together, such a constitution of the moral, combined with such a constitution of the material system, as demonstrates that the gradation of wealth in human society has its deep and its lasting foundation in the nature of things. And that the construction of such an economy, with all the conservative influences by which it is upholden,* attests both the wisdom and the benevolence of Him who is the Author of nature, may best be evinced by the momentous purposes, to which this surplus produce of land, (the great originator of all that can be termed affluence in the world) is subservient—“Had no ground yielded more in return for the labour expended on it, than the food of the cultivators and their secondaries, the existence of one and all of the human race would have been spent in mere labour. Every man would have been doomed to a life of unremitting toil for his bodily subsistence; and none could have been supported in a state of leisure, either for idleness, or for other employments than those of husbandry, and such coarser manufactories as serve to provide society with the second necessities of existence. The species would have

* See Art. 7 of this Chapter.

risen but a few degrees, whether physical or moral, above the condition of mere savages. It is just because of a fertility in the earth, by which it yields a surplus over and above the food of the direct and secondary labourers, that we can command the services of a disposable population, who, in return for their maintenance, minister to the proprietors of this surplus, all the higher comforts and elegancies of life. It is precisely to this surplus we owe it, that society is provided with more than a coarse and a bare supply for the necessities of animal nature. It is the original fund out of which are paid the expenses of art, and science, and civilization, and luxury, and law, and defence, and all, in short, that contributes either to strengthen or to adorn the commonwealth. Without this surplus, we should have had but an agrarian population—consisting of husbandmen, and those few homely and rustic artificers, who, scattered in hamlets over the land, would have given their secondary services to the whole population. It marks an interesting connexion between the capabilities of the soil, and the condition of social life, that to this surplus we stand indispensably indebted for our crowded cities, our thousand manufactories for the supply of comforts and refinements to society, our wide and diversified commerce, our armies of protection, our schools and colleges of education, our halls of legislation and justice, even our altars of piety and temple services. It has been remarked by geologists, as the evidence of a presiding design in nature, that the waste of the soil is so nicely balanced by the supply from the disintegration of the upland rocks, which are worn and pulverized at such a rate, as to keep up a good vegetable mould on the surface of the earth. But each science teems with the like evidences of a devising and intelligent God; and when we view aright the many beneficent functions, to which, through the instrumentality of its surplus produce, the actual degree of the earth's fertility is subservient, we cannot imagine a more wondrous and beautiful adaptation between the state of external nature and the mechanism of human society.”*

* Political Economy in connexion with the Moral State and Moral Prospects of Society. C. ii, Art. 10. In the appendix to this work on the subject of rent, there are further observations tending to prove that “there is an optimism in the actual constitution of the land, as in everything else that has proceeded from the hand of the Almighty.

CHAPTER VII.

On those special Affections which conduce to the economic well-being of Society.

1. WE now proceed to consider the economic, in contradistinction to the civil and political well-being of society, to the extent that this is dependent on certain mental tendencies—whether these can be demonstrated by analysis to be only secondary results or in themselves to be simple elements of the human constitution. We may be said indeed, to have already bordered on this part of our argument—when considering the origin and the rights of property; or the manner in which certain possessory affections, that appear even in the infancy of the mind and anticipate by many years the exercise of human wisdom, lead to a better distribution, both of the earth and of all the valuables which are upon it, than human wisdom could possibly have devised, or at least than human power without the help of these special affections could have carried into effect. For there might be a useful economy sanctioned by law, yet which law could not have securely established, unless it had had a foundation in nature. For in this respect, there is a limit to the force even of the mightiest despotism—insomuch that the most absolute monarch on the face of the earth must so far conform himself, to the indelible human nature of the subjects over whom he proudly bears the sway; else, in the reaction of their outraged principles and feelings, they would hurl him from his throne. And thus it is well, that, so very generally in the different countries of the world, law, both in her respect for the possessory and acquired rights of property and in her enforcement of them, has, instead of chalking out an arbitrary path for herself, only followed where nature beforehand had pointed the way. It is far better, that, rather than devise a jurisprudence made up of her own capricious inventions—she should, to so great an extent, have but ratified a prior jurisprudence, founded on the original or at least the universal affections of humanity. We know few things more instructive than a study of the mischievous effects, which attend a deviation from this course—of which we at present shall state two remarkable instances. The evils which ensue when law traverses any of those principles, that lie deeply seated in the very make and constitution of the mind, bring out into more striking exhibition the superior wisdom of that nature from which she has departed—even as the original perfection of a mechanism is never more fully demonstrated, than by the contrast of those repeated failures, which shows of every change or attempted improvement, that it but deranges or deteriorates the operations of the instrument in question. And thus too it is, that a les-

son of sound theology may be gathered, from the errors with their accompanying evils of unsound legislation—on those occasions when the wisdom of man comes into conflict and collision with the wisdom of God.

2. Of the two instances that we are now to produce, in which law hath made a deviation from nature, and done in consequence a tremendous quantity of evil, the first is the Tithe System of England. We do not think that the provision of her established clergy is in any way too liberal—but very much the reverse. Still we hold it signally unfortunate that it should have been levied so, as to do most unnecessary violence to the possessory feeling, both of the owners and occupiers of land all over the country. Had the tithe, like some other of the public burthens, been commuted into a pecuniary and yearly tax on the proprietors—the possessory feeling would not have been so painfully or so directly thwarted by it. But it is the constant intromission of the tithe agents or proctors with the fields, and the *ipsa corpora* that are within the limits of the property—which exposes this strong natural affection to an annoyance that is felt to be intolerable.* But far the best method of adjusting the state of the law to those principles of ownership which are anterior to law, and which all its authority is unable to quench—would be a commutation into land. Let the church property in each parish be dissevered in this way from its main territory; and then, both for the lay and the ecclesiastical domain, there would be an accordance of the legal with the possessory right. It is because these are in such painful dissonance, under the existing state of things, that there is so much exasperation in England, connected with the support and maintenance of her clergy. No doubt law can enforce her own arrangements, however arbitrary and unnatural they might be; but it is a striking exhibition, we have always thought, of the triumph of the possessory over the legal, that, in the contest between the two parties, the clergy have constantly been losing ground. And, in resistance to all the opprobrium which has been thrown upon them, do we affirm, that, with a disinterestedness which is almost heroic, they have, in deed and in practice, forborne to the average

* The following example of the thousands which might be alleged will show how apt the possessory feeling is to revolt against the legal right, and at length to overbear it.

The fee-simple of the Church property of the Dean and Chapter of Durham is in the Dean and Chapter of Durham.

The custom for ages has been to let houses on leases of forty years, and lands on leases of twenty-one years, at small reserved rents, these leases being renewable at the end of seven years, at the pleasure of the Dean and Chapter on the payment of arbitrary fines—which fines however as actually levied are exceedingly moderate, one year and a quarter being asked for houses, and one and a half for lands.

Several of the families of the occupiers of lands and houses so leased have been in possession for generations—and long possession has given to some of these occupiers such a strength of possessory feeling, that they have the sense of being aggrieved, if they do not get the renewals on their own terms.

extent of at least one half, the assertion of their claims. The truth is, that the felt odium which attaches to the system ought never to have fallen upon them. It is an inseparable consequence of the arrangement itself, by which law hath traversed nature—so as to be constantly rubbing, as it were, against that possessory feeling, which may be regarded as one of the strongest of her instincts. There are few reformatations that would do more to sweeten the breath of English society, than the removal of this sore annoyance—the brooding fountain of so many heartburnings and so many festerments, by which the elements of an unappeasable warfare are ever at work between the landed interest of the country, and far the most important class of its public functionaries; and, what is the saddest perversity of all, those, whose office it is by the mild persuasions of Christianity, to train the population of our land in the lessons of love and peace and righteousness—they are forced by the necessities of a system which many of them deplore, into the attitude of extortioners; and placed in that very current, along which a people's hatred and a people's obloquy are wholly unavoidable.* Even under the theocracy of the Jews, the system of tithes was with difficulty upholden; and many are the remonstrances which the gifted seers of Israel held with its people, for having brought of the lame and the diseased as offerings. Such, in fact, is the violence done by this system to the possessory feelings, that a conscientious submission to its exactions, may be regarded as a most decisive test of religious obedience—such an obedience, indeed, as was but ill maintained, even in the days of the Hebrew polity, although it had the force of temporal sanctions, with the miracles and manifestations of a presiding deity to sustain it. Unless by the express appointment of heaven, this yoke of Judaism, unaccompanied as it now is by the peculiar and preternatural enforcements of that dispensation, ought never to have been perpetuated in the days of Christianity. There are distinct, and, we hold, valid reasons, for the national maintenance of an order of men in the capacity of religious instructors to the people. But maintenance in a way so obnoxious to nature, is alike adverse to a sound civil and sound Christian policy. Both the cause of religion and the cause of loyalty have suffered by it. The alienation of the church's wealth, were a deadly blow to the best and highest interests of England: but there are few things would conduce more to the strength and peace of our nation, than a fair and right commutation of it.

* There is often the utmost injustice in that professional odium which is laid upon a whole order, and none have suffered more under it, than the clergy of England have, from the sweeping and indiscriminate charges, which have been preferred against them, by the demagogues of our land. We believe that nothing has given more of edge and currency to these invectives, than the very unfortunate way in which their maintenance has been provided for; and many are the amiable and accomplished individuals among themselves to whom it is a matter of downright agony.

3. Our next very flagrant example of a mischievous collision between the legal and the possessory, is the English system of poor laws. By law each man who can make good his plea of necessity, has a claim for the relief of it, from the owners or occupiers of the soil, or from the owners and occupiers of houses; and never, till the end of time, will all the authority, and all the enactments of the statute-book, be able to divest them of the feeling, that their property is invaded. Law never can so counterwork the strong possessory feeling, as to reconcile the proprietors of England to this legalised enormity, or rid them of the sensation of a perpetual violence. It is this mal-adjustment between the voice that nature gives forth on the right of property, and the voice that arbitrary law gives forth upon it—it is this, which begets something more than a painful insecurity as to the stability of their possessions. There is besides, a positive, and what we should call, a most natural irritation. That strong possessory feeling, by which each is wedded to his own domain in the relation of its rightful proprietor; and which they can no more help, because as much a part of their original constitution, than the parental feeling by which each is wedded to his own family in the relation of its natural protector—this strong possessory feeling, we say, is, under their existing economy, subject all over England to a perpetual and most painful annoyance. And accordingly we do find the utmost acerbity of tone and temper, among the upper classes of England, in reference to their poor. We are not sure, indeed, if there be any great difference, with many of them, between the feeling which they have towards the poor, and the feeling which they have towards poachers. It is true that the law is on the side of the one, and against the other. Yet it goes most strikingly to prove, how impossible it is for law to carry the acquiescence of the heart, when it contravenes the primary and urgent affections of nature—that paupers are in any degree assimilated to poachers in the public imagination; and that the inroads of both upon property should be resented, as if both alike were a sort of trespass or invasion.

4. And it is further interesting to observe the effect of this unnatural state of things on the paupers themselves. Even in their deportment, we might read an unconscious homage to the possessory right. And whereas, it has been argued in behalf of a poor-rate, that, so far from degrading, it sustains an independence of spirit among the peasantry, by turning that which would have been a matter of beggary into a matter of rightful and manly assertion—there is none who has attended the meeting of a parish vestry, that will not readily admit, the total dissimilarity which obtains between the assertion to a right of maintenance, and the assertion of any other right whatever, whether in the field of war or of patriotism. There may be much of the insolence of beggary; but along with this there is a most discernible mixture of its mean, and crouching, and igno-

ble sordidness. There is no common quality whatever between the clamorous onset of this worthless and dissipated crew, and the generous battle-cry *pro aris et focis*, in which the humblest of our population will join—when paternal acres, or the rights of any actually holden property are invaded. In the mind of the pauper, with all his challenging and all his boisterousness, there is still the latent impression, that, after all, there is a certain want of firmness about his plea. He is not altogether sure of the ground upon which he is standing; and, in spite of all that law has done to pervert his imagination, the possessory right of those against whom he prefers his demand, stares him in the face, and disturbs him not a little out of that confidence, wherewith a man represents and urges the demands of unquestionable justice. In spite of himself, he cannot avoid having somewhat the look and the consciousness of a poacher. And so the effect of England's most unfortunate blunder, has been, to alienate on the one hand her rich from her poor; and on the other to debase into the very spirit and sordidness of beggary, a large and ever-increasing mass of her population. There is but one way, we can never cease to affirm, by which this grievous distemper of the body politic can be removed. And that is, by causing the law of property to harmonise with the strong and universal instincts of nature in regard to it; by making the possessory right to be at least as inviolable as the common sense of mankind would make it; and as to the poor, by utterly recalling the blunder that England made, when she turned into a matter of legal constraint, that which should ever be a matter of love and liberty, and when she aggravated ten-fold the dependence and misery of the lower classes, by divorcing the cause of humanity from the willing generousities, the spontaneous and unforced sympathies of our nature.

5. But this brings into view another of our special affections—our compassion for the distress, including, as one of its most prominent and frequently recurring objects, our compassion for the destitution of others. We have already seen, how nature hath provided, by one of its implanted affections, for the establishment of property; and for the respect in which, amid all its inequalities, it is held by society. But helpless destitution forms one extreme of this inequality, which a mere system of property appears to leave out; and which, if not otherwise provided for by the wisdom of nature in the constitution of the human mind, would perhaps justify an attempt by the wisdom of man to provide for it in the constitution of human law. We do not instance, at present, certain other securities which have been instituted by the hand of nature, and which, if not traversed and enfeebled by a legislation wholly uncalled for, would of themselves, prevent the extensive prevalence of want in society. These are the urgent law of self-preservation, prompting to industry on the one hand and to economy on the other; and the strong law of relative affection—which laws, if not tampered with and undermined in

their force and efficacy by the law of pauperism, would not have relieved, but greatly better, would have prevented the vast majority of those cases which fill the workhouses, and swarm around the vestries of England. Still these, however, would not have prevented all poverty. A few instances, like those which are so quietly and manageably, but withal effectually met in the country parishes of Scotland, would still occur in every little community, however virtuous or well regulated. And in regard to these, there is another law of the mental constitution, by which nature hath made special provision for them—even the beautiful law of compassion, in virtue of which the sight of another in agony, (and most of all perhaps in the agony of pining hunger,) would, if unrelieved, create a sensation of discomfort in the heart of the observer, scarcely inferior to what he should have felt, had the suffering and the agony been his own.

6. But in England, the state, regardless of all the indices which nature had planted in the human constitution, hath taken the regulation of this matter into its own hands. By its law of pauperism, it hath, in the first instance, ordained for the poor a legal property in the soil; and thereby, running counter to the strong possessory affection, it hath done violence to the natural and original distribution of the land, and loosened the secure hold of each separate owner, on the portion which belongs to him. And in the second instance, distrustful of the efficacy of compassion, it, by way of helping forward its languid energies, hath applied the strong hand of power to it. Now it so happens, that nothing more effectually stifles compassion, or puts it to flight, than to be thus meddled with. The spirit of kindness utterly refuses the constraints of authority; and law in England, by taking the business of charity upon itself, instead of supplementing, hath well nigh destroyed the anterior provision made for it by nature—thus leaving it to be chiefly provided for, by methods and by a machinery of its own. The proper function of law is to enforce the rights of justice, or to defend against the violation of them; and never does it make a more flagrant or a more hurtful invasion, beyond the confines of its own legitimate territory—than, when confounding humanity with justice, it would apply the same enforcements to the one virtue as to the other. It should have taken a lesson from the strong and evident distinction which nature hath made between these two virtues, in her construction of our moral system; and should have observed a corresponding distinction in its own treatment of them—resenting the violation of the one; but leaving the other to the free interchanges of good-will on the side of the dispenser, and of gratitude on the side of the recipient. When law, distrustful of the compassion that is in all hearts, enacted a system of compulsory relief, lest, in our neglect of others, the indigent should starve; it did incomparably worse, than if, distrustful of the appetite of hunger, it had enacted for the use of food

a certain regimen of times and quantities, lest, neglectful of ourselves, our bodies might have perished. Nature has made a better provision than this for both these interests; but law has done more mischief by interference with the one, than it could ever have done by interference with the other. It could not have quelled the appetite of hunger, which still, in spite of all the law's officiousness, would have remained the great practical impellent to the use of food, for the well-being of our physical economy. But it has done much to quell and to overbear the affection of compassion—that never-failing impellent, in a free and natural state of things, to deeds of charity, for the well-being of the social economy. The evils which have ensued are of too potent and pressing a character to require description. They have placed England in a grievous dilemma, from which she can only be extricated, by the new modelling of this part of her statute-book, and a nearer conformity of its provisions to the principles of natural jurisprudence. Meanwhile they afford an emphatic demonstration for the superior wisdom of nature, which is never so decisively or so triumphantly attested, as by the mischief that is done, when her processes are contravened or her principles are violated.*

7. We are aware of a certain ethical system, that would obliterate the distinction between justice and humanity, by running or resolving the one into the other—affirming of the former more particularly, that all its virtue is founded on its utility; and that therefore justice, to which may be added truth, is no further a virtue, than as it is instrumental of good to men—thus making both truth and justice, mere species or modifications of benevolence. Now, as we have already stated, it is not with the theory of morals, but with the moral constitution of man that we have properly to do; and, most certain it is, that man does feel the moral rightness both of justice and truth, irrespective altogether of their consequences—or, at least, apart from any such view to these consequences at the time, as the mind is at all conscious of. There is an appetite of our sentient nature which terminates in food, and that is irrespective of all its subsequent utilities to the animal economy; and there is an appetite for doing what is right which terminates in virtue, and which bears as little respect to its utilities—whether for the good of self or for the good of society. The man whom some temptation to what is dishonourable would put into a state of recoil and restlessness, has no other aim, in the resistance he makes to it, than simply

* Without contending for the language of our older moralists, the distinction which they mean to express, by virtues of perfect and imperfect obligation, has a foundation in reality and in the nature of things—as between justice where the obligation on one side implies a counterpart right upon the other, and benevolence to which, whatever the obligation may be on the part of the dispenser, there is no corresponding right on the part of the recipient. The proper office of law is to enforce the former virtues. When it attempts to enforce the latter, it makes mischievous extension of itself beyond its own legitimate boundaries.

to make full acquittal of his integrity. This is his landing-place; and he looks no further. There may be a thousand dependent blessings to humanity, from the observation of moral rectitude. But the pure and simple appetency for rectitude, rests upon this as its object, without any onward reference to the consequences which shall flow from it. This consideration alone is sufficient to dispose of the system of utility—as being metaphysically incorrect in point of conception, and incorrect in the expression of it. If a man can do virtuously, when not aiming at the useful, and not so much as thinking of it—then to design and execute what is useful, may be and is a virtue; but it is not all virtue.*

8. There is one way in which a theorist may take refuge from this conclusion. It is quite palpable, that a man often feels himself to be doing virtuously—when, to all sense, he is not thinking of the utilities which follow in its train. But then it may be affirmed, that he really is so thinking—although he is not sensible of it. There can be little doubt of such being the actual economy of the world, such the existing arrangement of its laws and its sequences—that virtue and happiness are very closely associated; and that, no less in those instances, where the resulting happiness is not at all thought of, than in those where happiness is the direct and declared object of the virtue. Who can doubt that truth and justice bear as manifold and as important a subserviency to the good of the species as beneficence does?—and yet it is only with the latter, that this good is the object of our immediate contemplation. But then it is affirmed, that, when two terms are constantly associated in nature, there must be as constant an association of them in the mind of the observer of nature—an association at length so habitual, and therefore so rapid, that we become utterly unconscious of it. Of this we have examples, in the most frequent and familiar operations of human life. In the act of reading, every alphabetical letter must have been present to the mind—yet how many thousands of them, in the course of a single hour, must have passed in fleeting succession, without so much as one moment's sense of their presence, which the mind has any recollection of. And it is the same in listening to an acquaintance, when we receive the whole meaning and effect of his discourse, without the distinct consciousness of very many of those individual words which still were indispensable to the meaning. Nay, there are other and yet more inscrutable mysteries in the hu-

* If our moral judgment tell that some particular thing is right, without our adverting to its utility—then though all that we hold to be morally right should be proved by observation to yield the maximum of utility, utility is not on that account the mind's criterion for the rightness of this particular thing. God hath given us the sense of what is right; and He hath besides so ordained the system of things, that what is right is generally that which is most useful—yet, in many instances, it is not the perceived usefulness, which makes us recognise it to be right. We agree too with Bishop Butler in not venturing to assume that God's sole end in creation was the production of the greatest happiness.

man constitution; and which relate, not to the thoughts that we conceive without being sensible of them, but even to the volitions that we put forth, and to very many of which we are alike insensible. We have only to reflect on the number and complexity of those muscles which are put into action, in the mere processes of writing or walking, or even of so balancing ourselves as to maintain a posture of stability. It is understood to be at the bidding of the will, that each of our muscles performs its distinct office; and yet, out of the countless volitions, which had their part and their play, in these complicated, and yet withal most familiar and easily practicable operations—how many there are which wholly escape the eye of consciousness. And thus too, recourse may be had to the imagination of certain associating processes, too hidden for being the objects of sense at the time, and too fugitive for being the objects of remembrance afterwards. And on the strength of these it may be asked—how are we to know, that the utility of truth and justice is not present to the mind of man, when he discharges the obligation of these virtues; and how are we to know, that it is not the undiscoverable thought of this utility, which forms the impellent principle of that undiscoverable volition, by which man is urged to the performance of them?

9. Now we are precluded from replying to this question in any other way, than that the theory which requires such an argument for its support, may be said to fetch all its materials from the region of conjecture. It ventures on the affirmation of what is going on in a terra incognita; and we have not the means within our reach, for meeting it in the terms of a positive contradiction. But we can at least say, that a mere *argumentum ab ignorantia* is not a sufficient basis on which to ground a philosophic theory; and that thus to fetch an hypothesis from among the inscrutabilities of the mind, to speak of the processes going on there so quick and so evanescent that the eye of consciousness cannot discover them—is to rear a superstructure not upon the facts which lie within the limit of separation between the known and the unknown, but upon the fancies which lie without this limit. A great deal more is necessary for the establishment of an assertion, than that an adversary cannot disprove it. A thousand possibilities may be affirmed which are susceptible neither of proof nor of disproof; and surely it were the worst of logic to accept as proof, the mere circumstance that they are beyond the reach of disproof. They, in fact, lie alike beyond the reach of both; in which case they should be ranked among the figments of mere imagination, and not among the findings of experience. How are we to know but that, in the bosom of our great planetary amplitude, there do not float, and in elliptic orbits round the sun, pieces of matter vastly too diminutive for our telescopes; and that thus the large intermediate spaces between the known bodies of the system, instead of so many desolate blanks, are in fact peopled with little worlds—

all of them teeming, like our own, with busy and cheerful animation. Now, in the powerlessness of our existing telescopes, we do not know but it may be so. But we will not believe that it is so, till a telescope of power enough be invented, for disclosing this scene of wonders to our observation. And it is the same of the moral theory that now engages us. It rests, not upon what it finds among the arcana of the human spirit, but upon what it fancies to be there; and they are fancies too which we cannot deny, but which we will not admit—till, by some improved power of internal observation, they are turned into findings. We are quite sensible of the virtuousness of truth; but we have not yet been made sensible, that we always recognise this virtuousness, because of a glance we have had of the utility of truth—though only perhaps for a moment of time, too minute and microscopical for being noticed by the naked eye of consciousness. We can go no further upon this question than the light of evidence will carry us. And, while we both feel in our own bosoms and observe in the testimony of those around us, the moral deference which is due to truth and justice—we have not yet detected this to be the same with that deference, which we render to the virtue of benevolence. Or, in other words, we do venerate and regard these as virtues—while, *for aught we know*, the utility of them is not in all our thoughts. We agree with Dugald Stewart in thinking, that, “considerations of utility do not seem to us the only ground of the approbation we bestow on this disposition.” He further observes, that, “abstracting from all regard to consequences, there is something pleasing and amiable in sincerity, openness, and truth; something disagreeable and disgusting in duplicity, equivocation, and falsehood. Dr. Hutcheson himself, the great patron of that theory which resolves all moral qualities into benevolence, confesses this—for he speaks of a *sense* which leads us to approve of veracity, distinct from the sense which approves of qualities useful to mankind.”*

10. However difficult it may be, to resolve the objective question which respects the constitution of virtue in itself—in the subjective question, which respects the constitution of the mind, we cannot but acknowledge the broad and palpable distinction, which the Author of our moral frame hath made, between justice and truth on the one hand, and benevolence on the other. And it had been well, if law-givers had discriminated, as nature has done, between justice and humanity—although the mischief of their unfortunate deviation serves, all the more strikingly, to prove the adaptation of our moral constitution to the exigencies of human society. The law of pauperism hath assimilated beneficence to justice, by enacting the former, in the very way that it does the latter; and enforcing what it has thus enacted by penalties. Beneficence loses altogether its proper

* Stewart's "Outlines of Moral Philosophy," Art. Veracity.

and original character—when, instead of moving on the impulse of a spontaneous kindness that operates from within, it moves on the impulse of a legal obligation from without. Should law specify the yearly sum that must pass from my hands to the destitute around me—then, it is not beneficence which has to do with the matter. What I have to surrender, law hath already ordained to be the property of another; and I, in giving it up, am doing an act of justice and not an act of liberality. To exercise the virtue of beneficence, I must go beyond the sum that is specified by law; and thus law in her attempts to seize upon beneficence, and to bring her under rule, hath only forced her to retire within a narrower territory, on which alone it is that she can put forth the free and native characteristics which belong to her. Law, in fact, cannot, with any possible ingenuity, obtain an imperative hold on beneficence at all—for her very touch transforms this virtue into another. Should law go forth on the enterprise of arresting beneficence upon her own domain, and there laying upon her its authoritative dictates—it would find that beneficence had eluded its pursuit; and that all which it could possibly do, was to wrest from her that part of the domain of which it had taken occupation, and bring it under the authority of justice. When it thought to enact for beneficence, it only, in truth, enacted a new division of property; and in so doing, it contravenes the possessory, one of nature's special affections—while, by its attempts to force what should have been left to the free exercise of compassion, has done much to supersede or to extinguish another of these affections. It hath so pushed forward the line of demarcation—as to widen the space which justice might call her own, and to contract the space which beneficence might call her own. But never will law be able to make a captive of beneficence, or to lay personal arrest upon her. It might lessen and limit her means, or even starve her into utter annihilation. But never can it make a living captive of her. It is altogether a vain and hopeless undertaking to legislate on the duties of beneficence; for the very nature of this virtue, is to do good freely and willingly with its own. But on the moment that law interposes to any given extent with one's property, to that extent it ceases to be his own; and any good that is done by it is not done freely. The force of law and the freeness of love cannot amalgamate the one with the other. Like water and oil they are immiscible. We cannot translate beneficence into the statute-book of law, without expunging it from the statute-book of the heart; and, to whatever extent we make it the object of compulsion, to that extent we must destroy it.

11. And in the proportion that beneficence is put to flight, is gratitude put to flight along with it. The proper object of this emotion is another's good-will. But I do not hold as from the good-will of another, that which law hath enabled me to plea as my own right—nay to demand, with a front of hardy and resolute assertion.

It is this which makes it the most delicate and dangerous of all ground—when law offers to prescribe rules for the exercise of beneficence, or to lay its compulsory hand on a virtue, the very freedom of which is indispensable to its existence. And it not only extinguishes the virtue; but it puts an end to all those responses of glad and grateful emotion, which its presence and its smile and the generosity of its free-will offerings awaken in society. It is laying an arrest on all the music of living intercourse, thus to forbid those beautiful and delicious echoes, which are reflected, on every visit of unconstrained mercy, from those families that are gladdened by her footsteps. And what is worse, it is substituting in their place, the hoarse and jarring discords of the challenge and the conflict and the angry litigation. We may thus see, that there is a province in human affairs, on which law should make no entrance—a certain department of human virtue wherein the moralities should be left to their own unfettered play, else they shall be frozen into utter apathy—a field sacred to liberty and good-will that should ever be kept beyond the reach of jurisprudence; or on which, if she once obtain a footing, she will spoil it of all those unbought and unbidden graces that natively adorn it. So that while to law we would commit the defence of society from all the aggressions of violence, and confide the strict and the stern guardianship of the interests of justice—we should tremble for humanity lest it withered and expired under the grasp of so rough a protector; and lest before a countenance grave as that of a judge, and grim as that of a messenger-at-arms, this frail but loveliest of the virtues should be turned, as if by the head of Medusa, into stone.

12. But there are other moral ills in this unfortunate perversion, beside the extinction of good-will in the hearts of the affluent and of gratitude in the hearts of the poor—though it be no slight mischief to any community, that the tie of kindness between these two orders should have been broken; and that the business of charity, which when left spontaneous is so fertile in all the amenities of life, should be transformed into a fierce warfare of rights, from its very nature incapable of adjustment, and, whether they be the encroached upon or the repelled, subjecting both parties to the sense of a perpetual violence. But over and above this, there are other distempers, wherewith it hath smitten the social economy of England, and of which experience will supply the English observer with many a vivid recollection. The reckless but withal most natural improvidence of those whom the state has undertaken to provide for, seeing that law hath proclaimed in their favour a discharge from the cares and the duties of self-preservation—the headlong dissipation, in consequence—the dissolution of family ties, for the same public and proclaimed charity which absolves a man from attention to himself will absolve him also from attention to his relatives—the decay and interruption of sympathy in all the little vicinities of town

and country, for each man under this system of an assured and universal provision feels himself absolved too from attention to his neighbours—These distempers both social and economic have a common origin; and the excess of them above what taketh place in a natural state of things may all be traced to the unfortunate aberration, which, in this instance, the constitution of human law hath made from the constitution of human nature.

13. In our attempts to trace the rise of the possessory affection and of a sense of property, we have not been able to discover any foundation in nature, for a sentiment that we often hear impetuously urged by the advocates of the system of pauperism—that every man has a *right* to the means of subsistence. Nature does not connect this right with existence; but with continued occupation, and with another principle to which it also gives the sanction of its voice—that, each man is legitimate owner of the fruits of his own industry. These are the principles on which nature hath drawn her landmarks over every territory that is peopled and cultivated by human beings. And the actual distribution of property is the fruit, partly of man's own direct aim and acquisition, and partly of circumstances over which he had no control. The right of man to the means of existence on the sole ground that he exists has been loudly and vehemently asserted; yet is a factitious sentiment notwithstanding—tending to efface the distinctness of nature's landmarks, and to traverse those arrangements, by which she hath provided far better for the peace and comfort of society, nay for the more sure and liberal support of all its members. It is true that nature, in fixing the principles on which man has a right to the fruits of the earth, to the materials of his subsistence, has left out certain individuals of the human family—some outcast stragglers, who, on neither of nature's principles, will be found possessed of any right or of any property. It is for their sake that human law hath interposed, in some countries of the world; and, by creating or ordaining a right for them, has endeavoured to make good the deficiency of nature. But if justice alone could have ensured a right distribution for the supply of want, and if it must be through the medium of a right that the destitute shall obtain their maintenance—then, would there have been no need for another principle, which stands out most noticeably in our nature; and compassion would have been a superfluous part of the human constitution. It is thus that nature provides for the unprovided—not by unsettling their limits which her previous education had established in all minds—not by the extension of a right to every man; but by establishing in behalf of those some men, whom accident or the necessity of circumstances or even their own misconduct had left without a right, a compassionate interest in the bosom of their fellows. They have no advocate to plead for them at the bar of justice; and therefore nature hath furnished them with a gentler and more persuasive advocate, who might solicit for them at the bar

of mercy; and, for their express benefit, hath given to most men a near for pity, to many a hand open as day for melting charity. But it is not to any rare, or romantic generosity, that she hath confided the relief of their wants. She hath made compassion one of the strongest, and, in spite of all their depravations to which humanity is exposed, one of the steadiest of our universal instincts. It were an intolerable spectacle even to the inmates of a felon's cell, did they behold one of their fellows in the agonies of hunger; and rather than endure it, would they share their own scanty meal with them.* It were still more intolerable to the householders of any neighbourhood—insomuch that, where law had not attempted to supersede nature, every instance of distress or destitution would, whether in town or country, give rise to an internal operation of charity throughout every little vicinity of the land. The mischief which law hath done, by trying to mend the better mechanism which nature had instituted, is itself a most impressive testimony to the wisdom of nature. The perfection of her arrangements, is never more strikingly exhibited, than by those evils which the disturbance of them brings upon society—as when her law in the heart has been overborne by England's wretched law of pauperism; and this violation of the natural order has been followed up, in consequence, by a tenfold increase both of poverty and crime.

14. It is interesting to pursue the outgoings of such a system; and to ascertain whether nature hath vindicated her wisdom, by the evil consequences of a departure from her guidance on the part of man—for if so, it will supply another proof, or furnish us with another sight of the exquisite adaptation which she hath established between the moral and the physical, or between the two worlds of mind and matter. Certain, then, of the parishes of England have afforded a very near exemplification of the ultimate state to which one and all of them are tending—a state which is consummated, when the poor rates form so large a deduction from the rents of the land, that it shall at length cease to be an object to keep them in cultivation.†

* The certainty of this operation is beautifully exemplified in a passage of Mr. Buxton's interesting book on prisons—from which it appears that there is no allowance of food for the debtors, and a very inferior allowance of food to the criminals, who are confined in the gaol at Bristol. The former live on their own means or the casual charity of the benevolent. Instances have occurred when both of these resources failed them—and starvation would have ensued, had not the criminals, rather than endure the neighbourhood of such a suffering, shared their own scanty pittance along with them—thus affording an argumentum a fortiore for a like strength of compassion throughout the land—seeing that it had survived the depraving process which leads to the malefactor's cell.

† The following is an extract from the report of a select committee on the poor law printed in 1817. "The consequences which are likely to result from this state of things, are clearly set forth in the petition from the parish of Wombridge in Salop, which is fast approaching to this state. The petitioners state 'that the annual value of lands, mines and houses in this parish, is not sufficient to maintain the numerous and increasing poor, even if the same were set free of rent; and that

It is thus that some tracts of country are on the eve of being actually vacated by their proprietors; and as their place of superintendence cannot be vacated by others, who have no right of superintendence—the result might be, that whole estates shall be as effectually lost to the wealth and resources of the country, as if buried by an earthquake under water, or, as if some blight of nature has gone over them and bereft them of their powers of vegetation. Now we know not, if the whole history of the world furnishes a more striking demonstration than this, of the mischief that may be done, by attempting to carry into practice a theoretical speculation, which, under the guise and even with the real purpose of benevolence, has for its plausible object, to equalize among the children of one common humanity, the blessings and the fruits of one common inheritance. The truth is that we have not been conducted to the present state of our rights and arrangements respecting property, by any artificial process of legislation at all. The state of property in which we find ourselves actually landed, is the result of a natural process, under which, all that a man earns by his industry is acknowledged to be his own—or, when the original mode of acquisition is lost sight of, all that a man retains by long and undisturbed possession is felt and acknowledged to be his own also. Legislation ought to do no more than barely recognise these principles, and defend its subjects against the violation of them. And when it attempts more than this—when it offers to tamper with the great arrangements of nature, by placing the rights and the securities of property on a footing different from that of nature—when, as in the case of the English poor-laws, it does so, under the pretence and doubtless too with the honest design of establishing between the rich and the poor a nearer equality of enjoyment; we know not in what way violated nature could have inflicted on the enterprise a more signal and instructive chastisement, than when the whole territory of this plausible but presumptuous experiment is made to droop and to wither under it as if struck by a judgment from heaven—till at length that earth out of which the rich draw all their wealth and the poor all their subsistence, refuses to nourish the children who have abandoned her; and both parties are involved in the wreck of one common and overwhelming visitation.

15. But we read the same lesson in all the laws and movements of political economy. The superior wisdom of nature is demonstrated in the mischief which is done by any aberration th refrom—

these circumstances will inevitably compel the occupiers of lands and mines to relinquish them; and the poor will be without relief, or any known mode of obtaining it, unless some assistance be speedily afforded to them.’ And your committee apprehend, from the petition before them, that this is one of many parishes that are fast approaching to a state of dereliction.”

The inquiries of the present Poor law Commission have led to a still more aggravated and confirmed view of the evils of the system.

when her processes are disturbed or intermeddled with by the wisdom of man. The philosophy of free trade is grounded on the principle, that society is most enriched or best served, when commerce is left to its own spontaneous evolutions; and is neither fostered by the artificial encouragements, nor fettered by the artificial restraints of human policy. The greatest economic good is rendered to the community, by each man being left to consult and to labour for his own particular good—or, in other words, a more prosperous result is obtained by the spontaneous play and busy competition of many thousand wills, each bent on the prosecution of its own selfishness, than by the anxious superintendence of a government, vainly attempting to medicate the fancied imperfections of nature, or to improve on the arrangements of her previous and better mechanism. It is when each man is left to seek, with concentrated and exclusive aim, his own individual benefit—it is then, that markets are best supplied; that commodities are furnished for general use, of best quality, and in greatest cheapness and abundance; that the comforts of life are most multiplied; and the most free and rapid augmentation takes place in the riches and resources of the commonwealth. Such a result, which at the same time not a single agent in this vast and complicated system of trade contemplates or cares for, each caring only for himself—strongly bespeaks a higher agent, by whose transcendental wisdom it is, that all is made to conspire so harmoniously and to terminate so beneficially. We are apt to recognise no higher wisdom than that of man, in those mighty concerts of human agency—a battle, or a revolution, or the accomplishment of some prosperous and pacific scheme of universal education; where each who shares in the undertaking is aware of its object, or acts in obedience to some master-mind who may have devised and who actuates the whole. But it is widely different, when, as in political economy, some great and beneficent end both unlooked and unlaboured for, is the result, not of any concert or general purpose among the thousands who are engaged in it—but is the compound effect, nevertheless, of each looking severally, and in the strenuous pursuit of individual advantage, to some distinct object of his own. When we behold the working of a complex inanimate machine, and the usefulness of its products—we infer, from the unconsciousness of all its parts, that there must have been a planning and a presiding wisdom in the construction of it. The conclusion is not the less obvious, we think it emphatically more so, when, instead of this, we behold in one of the animate machines of human society, the busy world of trade, a beneficent result, an optimism of public and economical advantage, wrought out by the free movements of a vast multitude of men, not one of whom had the advantage of the public in all his thoughts. When good is effected by a combination of unconscious agents incapable of all aim, we ascribe the combination to an intellect that devised and gave it birth. When good is effected by a combination

of conscious agents capable of aim, but that an aim wholly different with each from the compound and general result of their united operations—this bespeaks a higher will and a higher wisdom than any by which the individuals, taken separately, are actuated. When we look at each striving to better his own condition, we see nothing in this but the selfishness of man. When we look at the effect of this universal principle, in cheapening and multiplying to the uttermost all the articles of human enjoyment, and establishing a thousand reciprocities of mutual interest in the world—we see in this the benevolence and comprehensive wisdom of God.

16. The whole science of Political Economy is full of those exquisite adaptations to the wants and the comforts of human life, which bespeak the skill of a master-hand, in the adjustment of its laws, and the working of its profoundly constructed mechanism. We shall instance, first, that specialty in the law of prices, by which they oscillate more largely with the varieties in the supply of the necessaries, than they do in the mere comforts or luxuries of human life. The deficiency of one tenth in the imports of sugar, would not so raise the price of that article, as a similar deficiency in the supply of corn, which might rise even a third in price, by the diminution of a tenth from the usual quantity brought to market. It is not with the reason, but with the beneficial effect of this phenomenon, that we at present have to do—not with its efficient, but with its final cause; or the great and obvious utilities to which it is subservient. Connected with this law of wider variation in the price than in the supply of first necessaries, is the reason why a population survive so well those years of famine, when the prices perhaps are tripled. This does not argue that they must be therefore three times worse fed than usual. The food of the country may only, for aught we know, have been lessened by a fourth part of its usual supply—or, in other words, the families may at an average be served with three-fourths of their usual subsistence, at the very time that the cost of it is three times greater than usual. And to make out this large payment, they have to retrench for the year in other articles—altogether, it is likely, to give up the use of comforts; and to limit themselves more largely in the second, than they can possibly do in the first necessaries of life—to forego perhaps many of the little seasonings, wherewith they wont to impart a relish to their coarse and humble fare—to husband more strictly their fuel; and be satisfied for a time with vestments more threadbare, and even more tattered, that what in better times they would choose to appear in. It is thus that even although the first necessaries should be tripled in price for a season, and although the pecuniary income of the labouring classes should not at all be increased—yet they are found to weather the hardships of such a visitation. The food is still served out to them at a much larger proportion than the cost of it would in the first instance appear to indicate. And in the second instance they are enabled to purchase at this cost—because, and

more especially if they be a well-habited and well conditioned peasantry, with a pretty high standard of enjoyment in ordinary years, they have more that they can save and retrench upon in a year of severe scarcity. They can disengage much of that revenue which before went to the purchase of dress, and of various luxuries that might for a season be dispensed with; and so have the more to expend on the materials of subsistence. It is this which explains how roughly a population can bear to be handled, both by adverse seasons and by the vicissitudes of trade; and how after all, there is a stability about a people's means, which will keep its ground against many checks, and amidst many fluctuations. It is a mystery and a marvel to many an observer, how the seemingly frail and precarious interest of the labouring classes should after all, have the stamina of such endurance as to weather the most fearful reverses both of commerce and of the seasons; and that, somehow or other, we find after an interval of gloomy suffering and still gloomier fears, that the families do emerge again into the same state of sufficiency as before. We know not a fitter study for the philanthropist than the working of that mechanism, by which a process so gratifying is caused, or in which we will find greater reason to admire the exquisite skill of those various adaptations that must be referred to the providence of Him who framed society, and suited so wisely to each other the elements of which it is composed.

17. There is nought which appears more variable than the operation of those elements by which the annual supply of the national subsistence is regulated. How unlike in character is one season to another; and between the extremes of dryness and moisture, how exceedingly different may be the amount of that produce on which the sustenance of man essentially depends. Even after that the promise of abundance is well nigh realised, the hurricane of a single day, passing over the yet uncut but ripened corn; or the rain of a few weeks, to drench and macerate the sheaves that lie piled together on the harvest-field, were enough to destroy the food of millions. We are aware of a compensation, in the varieties of soil and exposure, so that the weather which is adverse to one part of the country might be favourable to another; besides that the mischief of a desolating tempest in autumn must only be partial, from the harvest of the plains and uplands falling upon different months. Still, with all these balancing causes, the produce of different years is very far from being equalised; and its fluctuations would come charged with still more of distress and destitution to families—were there not a counterpoise to the laws of nature, in what may be termed the laws of political economy.

18. The price of human food does not immediately depend on the quantity of it that is produced, but on the quantity of it that is brought to market; and it is well that, in every year of scarcity, there should be instant causes put into operation for increasing the latter quantity to the uttermost—so as to repair as much as possible the deficiencies

of the former. It is well that even a small short-coming in the crop should be so surely followed by a great advance of prices; for this has instantly the effect of putting the families of the land upon that shortness of allowance, which might cause the supply, limited as it is, to serve throughout the year. But, besides the wholesome restraint which is thus imposed on the general consumption of families, there is encouragement given by this dearness to abridge the consumption upon farms, and by certain shifts in their management to make out the greatest possible surplus, for the object of sale and supply to the population at large. With a high price, the farmer feels it a more urgent interest, to carry as much of his produce to market as he can; and for this purpose, he will retrench to the uttermost at home. And he has much in his power. More particularly, he can and does retrench considerably upon the feed of his cattle, and in as far as this wont to consist of potatoes or grain, there must an important addition be gained in this way to the supplies of the market. One must often have been struck with the comparative cheapness of animal food in a year of scarcity. This is because of the greater slaughter of cattle which takes place in such a year, to save the heavy expense of maintaining them; and which, besides affording a direct accession to the sustenance of man, lightens still more the farm consumption, and disengages for sale a still greater amount of the necessaries of life. We do not say but that the farm suffers derangement by this change of regimen, from which it might take years to recover fully. But the evil becomes more tolerable by being spread. The horrors of extreme scarcity are prevented. The extremity is weathered at its furthest point. The country emerges from the visitation, and without, in all probability, the starvation of one individual; and all because, from the operation of the causes that we have now explained, the supply of the market is made to oscillate within smaller limits than the crop—insomuch that though the latter should be deficient by one-third of the whole, the former might not be deficient by one-fifth or one-sixth of what is brought to market annually.

19. This effect is greatly increased by the suspending of distillation in years of scarcity. And after all, should the supplies be yet very short, and the prices therefore far more than proportionally high, this will naturally and of itself, bring on the importation of grain from foreign parts. If such be the variety of weather and soil, even within the limits of a country, as in some measure to balance the scarcity which is experienced in one set of farms by the comparative abundance of another set—this will apply with much greater force to a whole continent, or to the world at large. If a small deficiency in the home supply of grain induce a higher price than with other articles of commerce, this is just a provision for a securer and readier filling up of the deficiency by a movement from abroad—a thing of far greater importance with the necessa-

ries than with the mere comforts or luxuries of life. That law of wider and more tremulous oscillation in the price of corn, which we have attempted to expound, is in itself a security for a more equal distribution of it over the globe by man, in those seasons when nature has been partial—so as to diffuse the more certainly and the more speedily through the earth that which has been dropped upon it unequally from Heaven. It is well that greater efficacy should thus be given to that corrective force, by which the yearly supplies of food are spread over the world with greater uniformity than they at first descend upon it; and, however much it may be thought to aggravate a people's hardships, that a slight failure in their home supply should create such a rise in the cost of necessaries—yet certainly it makes the impulse all the more powerful, by which corn flows in from lands of plenty to a land of famine. But what we have long esteemed the most beautiful part of this operation, is the instant advantage, which a large importation from abroad gives to our export manufactures at home. There is a limit in the rate of exchange to the exportation of articles from any country; but up to this limit, there is a class of labourers employed in the preparation of these articles. Now the effect of an augmented importation upon the exchange is such as to enlarge this limit—so that our export traders can then sell with a larger profit, and carry out a greater amount of goods than before, and thus enlist a more numerous population in the service of preparing them. An increased importation always gives an impulse to exportation, so as to make employment spring up in one quarter, at the very time that it disappears in another. Or, rather, at the very time when the demand for a particular commodity is slackened at home, it is stimulated abroad. We have already adverted to the way in which families shift their expenditure in a year of scarcity, directing a far greater proportion of it than usual to the first necessities of life, and withdrawing it proportionally from the comforts, and even second necessities of life. Cloth may be regarded as one of the second necessities; and it were woful indeed, if on the precise year when food was dearest, the numerous workmen engaged in this branch of industry should find that employment was scarcest. But in very proportion as they are abandoned by customers at home, do they find a compensation in the more quickened demand of customers from abroad. It is in these various ways that a country is found to survive so well its hardest and heaviest visitations; and even under a triple price for the first articles of subsistence, it has been found to emerge into prosperity again, without an authentic instance of starvation throughout all its families.*

* It is right to mention that the four preceding paragraphs are taken in substance, and very much in language, from a former publication—as presenting a notable adaptation of external to human nature which offered itself, in the course of other investigations, and at a time when we were not in quest of it.

20. When any given object is anxiously cared for by a legislature, and all its wisdom is put forth in devising measures for securing or extending it—it forms a pleasing discovery to find, that what may have hitherto been the laborious aim and effort of human policy, has already been provided for, with all perfection and entireness in the spontaneous workings of human nature; and that therefore, in this instance, the wisdom of the state has been anticipated by a higher wisdom—or the wisdom which presides over the ordinations of a human government, has been anticipated by the wisdom which ordained the laws of human constitution. Of this there are manifold examples in political economy—as in the object of population, for the keeping up and increase of which, there was at one time a misplaced anxiety on the part of rulers; and the object of capital for the preservation and growth of which there is a like misplaced anxiety, and for the decay and disappearance of which there is an equally misplaced alarm. Both, in fact, are what may be termed self-regulating interests—or, in other words, interests which result with so much certainty from the checks and the principles that nature hath already instituted, as to supersede all public or patriotic regulation in regard to either of them. This has now been long understood on the subject of population; but it holds equally true on the subject of capital. There is, on the one hand, throughout society enough of the appetite for enjoyment, to secure us against its needless excess; and, on the other, enough of the appetite for gain, to secure us against its hurtful deficiency. And, by a law of oscillation as beautiful as that which obtains in the planetary system, and by which amid all disturbances and errors, it is upheld in its mean state indestructible and inviolate—does capital in like manner, constantly tend to a condition of optimism, and is never far from it, amid all the variations, whether of defect, or redundancy, to which it is exposed. When in defect, by the operation of high prices, it almost instantly recovers itself—when in excess, it, by the operation of low profits, or rather of losing speculations, almost instantly collapses into a right mediocrity. In the first case, the inducement is to trade rather than to spend; and there is a speedy accumulation of capital. In the second case, the inducement is to spend rather than to trade; and there is a speedy reduction of capital. It is thus that capital ever suits itself, in the way that is best possible, to the circumstances of the country—so as to leave uncalled for, any economic regulation by the wisdom of man; and that precisely because of a previous moral and mental regulation by the wisdom of God.

21. But if anything can demonstrate the hand of a righteous Deity in the nature and workings of what may well be termed a mechanism the very peculiar mechanism of trade; it is the healthful impulse given to all its movements, wherever there is a reigning principle of sobriety and virtue in the land—so as to ensure an inseparable connexion between the moral worth and the economic comfort of a

people. Of this we should meet with innumerable verifications in political economy—did we make a study of the science, with the express design of fixing and ascertaining them. There is one very beautiful instance in the effect, which the frugality and foresight of workmen would have, to control and equalize the fluctuations of commerce—acting with the power of a fly in mechanics; and so as to save, or at least indefinitely to shorten, those dreary intervals of suspended work or miserable wages, which now occur so often, and with almost periodic regularity in the trading world. What constitutes a sore aggravation to the wretchedness of such a season, is the necessity of overworking—so as, if possible, to compensate by the amount of labour for the deficiency of its remuneration; and yet the inverse effect of this in augmenting and perpetuating that glut, or overproduction, which is the real origin of this whole calamity. It would not happen in the hands of a people elevated and exempted above the urgencies of immediate want; and nothing will so elevate and exempt them, but their own accumulated wealth—the produce of a resolute economy and good management in prosperous times. Would they only save during high wages, what they might spend during low wages—so as when the depression comes, to slacken, instead of adding to their work, or even cease from it altogether—could they only afford to live through the months of such a visitation, on their well-husbanded means, the commodities of the overladen market would soon clear away; when, with the return of a brisk demand on empty warehouses, a few weeks instead of months would restore them to importance and prosperity in the commonwealth. This is but a single specimen from many others of that enlargement which awaits the labouring classes, after that by their own intelligence and virtue, they have won their way to it. With but wisdom and goodness among the common people, the whole of this economic machinery would work most beneficently for them—a moral ordination, containing in it most direct evidence for the wisdom and goodness of that Being by whose hands it is the machinery has been framed and constituted; and who, the Preserver and Governor, as well as the Creator of His works, sits with presiding authority over all its evolutions.

22. But this is only one specimen out of the many—the particular instance of a quality that is universal, and which may be detected in almost all the phenomena and principles of the science; for throughout, political economy is but one grand exemplification of the alliance, which a God of righteousness hath established, between prudence and moral principle on the one hand, and physical comfort on the other. However obnoxious the modern doctrine of population, as expounded by Mr. Malthus, may have been, and still is, to weak and limited sentimentalists, it is the truth which of all others sheds the greatest brightness over the earthly prospects of humanity—and this in spite of the hideous, the yet sustained outcry which

has risen against it. This is a pure case of adaptation, between the external nature of the world in which we live, and the moral nature of man, its chief occupier. There is a demonstrable inadequacy in all the material resources which the globe can furnish, for the increasing wants of a recklessly increasing species. But over and against this, man is gifted with a moral and a mental power by which the inadequacy might be fully countervailed; and the species, in virtue of their restrained and regulated numbers, be upholden on the face of our world, in circumstances of large and staple sufficiency, even to the most distant ages. The first origin of this blissful consummation is in the virtue of the people; but carried into sure and lasting effect by the laws of political economy, through the indissoluble connexion which obtains between the wages and the supply of labour—so that in every given state of commerce and civilization, the amount of the produce of industry and of the produce of the soil, which shall fall to the share of the workmen, is virtually at the determination of the workmen themselves, who, by dint of resolute prudence and resolute principle together, may rise to an indefinitely higher status than they now occupy, of comfort and independence in the commonwealth. This opens up a cheering prospect to the lovers of our race; and not the less so, that it is seen through the medium of popular intelligence and virtue—the only medium through which it can ever be realized. And it sheds a revelation, not only on the hopeful destinies of man, but on the character of God—in having instituted this palpable alliance between the moral and the physical; and so assorted the economy of outward nature to the economy of human principles and passions. The lights of modern science have made us apprehend more clearly, by what steps the condition and the character of the common people rise and fall with each other—inasmuch, that, while on the one hand their general destitution is the inevitable result of their general worthlessness, they, on the other, by dint of wisdom and moral strength, can augment indefinitely, not the produce of the earth, nor the produce of human industry, but that proportion of both which falls to their own share. Their economic is sure to follow by successive advances in the career of their moral elevation; nor do we hold it impossible, or even unlikely—that gaining, every generation, on the distance which now separates them from the upper classes of society, they shall, in respect both of decent sufficiency and dignified leisure, make perpetual approximations to the fellowships and enjoyments of cultivated life.

CHAPTER VIII.

On the Relation in which the special Affections of our Nature stand to Virtue ; and on the Demonstration given forth by it, both to the Character of Man and the Character of God.

1. THERE are certain broad and decisive indications of moral design, and so of a moral designer, in the constitution of our world, which instead of expounding at great length, we have only stated briefly or incidentally—because, however effective as proofs, they possess a character of such extreme obviousness, as to require no anxious or formal explanation ; but, on the instant of being presented to their notice, are read and recognised by all men. One patent example of this in the constitution of man, is the force and prevalence of compassion—an endowment which could not have proceeded from a malignant being ; but which evinces the Author of our nature to be himself compassionate and generous. Another example may be given alike patent and recognisable, if not of a virtuous principle in the human constitution, at least of such an adaptation of the external world to that constitution—that, with the virtuous practice which that principle would both originate and sustain, the outward and general prosperity of man is indispensably connected. We mean the manifest and indispensable subserviency of a general truth in the world, to the general well-being of society. It is difficult to imagine, that a God of infinite power, and consummate skill of workmanship, but withal a lover of falsehood, would have devised such a world ; or rather, that he would not, in patronage to those of his own likeness, have ordered the whole of its system differently—so reversing its present laws and sequences, as that, instead of honour and integrity, duplicity, disingenuousness and fraud, should have been the usual stepping-stones to the possession both of this world's esteem and of this world's enjoyments. How palpably opposite this is to the actual economy of things, the whole experience of life abundantly testifies—making it evident, of individual examples, that the connexion between honesty and success in the world is the rule ; the connexion between dishonesty and success is the exception. But perhaps, instead of attempting the induction of particular cases, we should observe a still more distinct avowal of the character of God, of his favour for truth, and of the discountenance which he has laid upon falsehood, by tracing, which could be easily done in imagination, the effect it would have in society, if, all things else remaining unaltered, there should this single difference be introduced, of a predominant falsehood, instead of a predominant truth in the world. The consequences of a universal distrust, in the almost universal stoppage that would ensue of the useful in-

terchanges of life, are too obvious to be enumerated. The world of trade would henceforth break up into a state of anarchy, or rather be paralyzed into a state of cessation and stillness. The mutual confidence between man and man, if not the mainspring of commerce, is at least the oil, without which its movements were impracticable. And were truth to disappear, and all dependence on human testimony to be destroyed, this is not the only interest which would be ruined by it. It would vitiate, and that incurably, every social and every domestic relationship; and all the charities as well as all the comforts of life would take their departure from the world.

2. Seeing then that the observation of honesty and truth is of such vital importance to society, that without it society would cease to keep together—it might be well to ascertain, by what special provision it is in the constitution of man, that the practice of these virtues is upheld in the world. Did it proceed in every instance, from the natural power and love of integrity in the heart—we should rejoice in contemplating this alliance between the worth of man's character, on the one hand; and the security, as well as the abundance of his outward comforts upon the other. And such, in fact, is the habitual disposition to truth in the world—that, in spite of the great moral depravation into which our species has obviously fallen, we probably do not overrate the proportion, when we affirm, that at least a hundred truths are uttered among men for one falsehood. But then in the vast majority of cases, there is no temptation to struggle with, nothing by which to try or to estimate the strength of the virtue so that, without virtue being at all concerned—in it, man's words might spontaneously flow in the natural current of his ideas, of the knowledge or the convictions which belong to him. But more than this. Instead of selfishness seducing man, which it often does, from the observations of truth and honesty—it vastly oftener is on the side of these observations. Generally speaking, it is not more his interest that he should have men of integrity to deal with—than that he himself should, in his own dealings, be strictly observant of this virtue. To be abandoned by the confidence of his fellows, he would find to be not more mortifying to his pride, than ruinous to his prosperity in the world. We are aware that many an occasional harvest is made from deceit and injustice; but, in the vast majority of cases, men would cease to thrive when they ceased to be trusted. A man's actual truth is not more beneficial to others, than the reputation of it is gainful to himself. And therefore it is, that, throughout the mercantile world, men are as sensitive of an aspersion on their name, as they would be of an encroachment on their property. The one, in fact, is tantamount to the other. It is thus, that, under the constraints of selfishness alone, fidelity and justice may be in copious and current observation among men; and while, perhaps, the principle of these virtues is exceedingly frail

and uncertain in all hearts—human society may still subsist by the literal and outward observation of them.

3. Here then is the example, not of a virtue in principle, but of a virtue in performance, with all the indispensable benefits of that performance, being sustained on the soil of selfishness. Were a profound observer of human life to take account of all the honesties of mercantile intercourse, he would find, that, in the general amount of them, they were mainly due to the operation of this cause; or that they were so prevalent in society, because each man was bound to their observance, by the tie of his own personal interest—insomuch that if this particular tie were broken, it would as surely derange or break up the world of trade, as the world of matter would become an inert or turbid chaos, on the repeal or suspension of the law of gravitation. Confidence, the very soul of commercial enterprise, and without which the transactions of merchandise were impossible, is the goodly result, not of that native respect which each man has for another's rights, but of that native regard which each man has for his own special advantage. This forms another example of a great and general good wrought out for society—while each component member is intently set, only on a distinct and specific good for himself—a high interest, which could not have been confided to human virtue; but which has been skilfully extracted from the workings of human selfishness. In as far as truth and justice prevail in the world, not by the operation of principle but of policy, in so far the goodness of man has no share in it: but so beneficent a result out of such unpromising materials, speaks all the more emphatically both for the wisdom and the goodness of God.

4. But in this there is no singularity. Other examples can be named, of God placing us in such circumstances, as to enlist even our selfishness on the side of virtuous conduct; or implanting such special affections, as do, by their own impulse, lead to that conduct, although virtuousness is not in all our thoughts. We are often so actuated, as to do what is best for society, at the very time that the good of society is forming no part of our concern; and our footsteps are often directed in that very path, which a moral regard to the greatest happiness of the species would dictate—without any moral purpose having been conceived or any moral principle been in exercise within us. It is thus that our resentment operates as a check on the injuriousness of others, although our single aim be the protection of our own interests—not the diminution of violence or injustice in the world: And thus too our own dread of resentment from others, works the same outward effect, which honour or a respect for their rights would have had upon our transactions, which delicacy or a respect for their feelings would have had upon our converse with those around us. It is in this way that God makes the wrath of man to praise Him; and the same is true of other af-

fections of our nature, which have less the character of selfishness, than either anger or fear. It is not because prompted by a sense of duty, but under the force of a mere natural proneness, that mothers watch so assiduously over the helplessness, and fathers toil so painfully for the subsistence of their children. Even compassion, with the speed and the discrimination of its movements, does for human life, more than man is capable of doing with his highest efforts of morality and reason—yet, not in the shape of a principle, but in the shape of a strong constitutional propensity. The good is rendered, not by man acting as he thinks that he ought, or under the force of a moral suggestion; but man acting because he feels himself constrained, as if by the force of a physical necessity—not surely because, in the exercise of a sovereign liberty, he hath assumed a lordly ascendancy over all the inferior passions of his nature; but because himself is lording over by a law of his nature, having in it all the might and mastery of a passion. It is when, in the contemplation of phenomena like these, we are enabled to view man as an instrument, that we are also led more clearly to perceive who the agent is—not the being who is endowed, but the Being who has endowed him. The instinct of animals is a substitute for their wisdom; but, at the same time, a palpable demonstration of the wisdom of God. Man also has his instincts, which serve as the substitutes of moral goodness in him; but which therefore mark all the more strongly, by their beneficial operation the goodness of his Maker.*

5. To see how widely these gifts or endowments of our nature by the hand of God, may stand apart from aught like proper goodness or virtue in the heart of man—we have only to witness the similar provision which has been made for the care and preservation of the inferior animals. The anger which arouses to defence against injury, and the fear which prompts to an escape from it, and the natural affection which nourishes and rears forward the successive young into a condition of strength and independence for the protection of themselves—these all have their indispensable uses, for upholding and perpetuating the various tribes of living creatures, who at the same time are alike incapable of morality and reason. There is no *moral* purpose served by these implantations, so far at least as respects the creatures themselves, with whom virtue is a thing utterly incompetent and unattainable. In reference to them, they may be viewed simply as beneficent contrivances, and as bespeak-

* Dr. Smith in his Theory of Moral Sentiments has well remarked that—"though in accounting for the operations of bodies, we never fail to distinguish the efficient from the final cause, in accounting for those of the mind, we are very apt to confound those two different things with one another. When by natural principles we are led to advance those ends which a refined and enlightened reason would recommend to us, we are very apt to impute to that reason, as to their efficient cause, the sentiments and actions by which we advance those ends, and to imagine that to be the wisdom of man, which in reality is the wisdom of God."

ing no other characteristic on the part of the Deity than that of pure kindness, or regard for the happiness and safety, throughout their respective generations, of the creatures whom he has made. This might help us to distinguish between those mental endowments of our own species, which have but for their object the comfort and protection; and those which have for their object the character of man. The former we have in common with the inferior animals; and so far they only discover to us the kindness of the divine nature, or the parental and benevolent concern which God takes in us. The latter are peculiar to our race, and are indicated by certain phenomena of our mental nature, in which the beasts of the field and the fowls of the air have no share with us—by the conscience within us, asserting its own rightful supremacy over all our affections and doings; by our capacities for virtue and vice, along with the pleasures or the pains which are respectively blended with them; and finally by the operation of habit, whose office, like that of a school-master, is to perfect our education, and to fix, in one way or other, but at length unmoveably, the character of its disciples. These present us with a distinct exhibition of the Deity, or a distinct and additional relation in which He stands to us—revealing to us, not Him only as the affectionate Father, and ourselves only as the fondlings of His regard; but Him also as the great moral Teacher, the Lawgiver, and moral Governor of man, and ourselves in a state of pupillage and probation, or as the subjects of a moral discipline.

6. And here it may be proper to remark, that we understand by the goodness of God, not His benevolence or His kindness alone. The term is comprehensive of all moral excellence. Truth, and justice, and that strong repugnance to moral evil which has received the peculiar denomination of Holiness—these are all good moral properties, and so enter into the composition of perfect moral goodness. There are some who have analysed, or, in the mere force of their own wishfulness, would resolve the whole character of the Deity into but one attribute—that of a placid undistinguishing tenderness; and, in virtue of this tasteful or sentimental but withal meagre imagination, would they despoil Him of all sovereignty and of all sacredness—holding Him forth as but the indulgent father, and not also as the righteous Governor of men. But this analysis is as impracticable in the character of God, as we have already found it to be in the character of man.* Unsophisticated conscience speaks differently. The forebodings of the human spirit in regard to futurity, as well as the present phenomena of human life, point to truth and righteousness, as distinct and stable and independent perfections of the divine nature—however glossed or disguised they may have been, by the patrons of a mild and easy religion. In the various provisions of nature for the defence and security of the inferior animals, we may read but one lesson—the benevolence of its

* Chap. vii. Art. 7.

Author. In the like provisions, whether for the defence and prolongation of human life, or the maintenance of human society—we read that lesson too, but other lessons in conjunction with it. For in the larger capacities of man, and more especially in his possession of a moral nature, do we regard him as born for something ulterior and something higher than the passing enjoyments of a brief and ephemeral existence. And so when we witness in the provisions, whether of his animal or mental economy, a subserviency to the protection, or even to the enjoyments of his transition state—we cannot disconnect this with subserviency to the remoter objects of that ultimate state whither he is going. In the instinctive fondness of parents, and the affinities of kindness from the fellows of our species, and even the private affections of anger and fear,—we behold so many elements conjoined into what may be termed an apparatus of guardianship; and such an apparatus has been reared by Providence in behalf of every creature that breathes. But in the case of man, with his larger capacities and prospects, the terminating object, even of such an intermediate and temporary apparatus, is not to secure for him, the safety or happiness of the present life. It is to fulfil the period, and subserve the purposes of a moral discipline. For meanwhile character is ripening; and, whether good or bad, settling by the power and operation of habit into a state of inveteracy—and so, as to fix and prepare the disciples of a probationary state for their final destinations. What to the inferior animals are the provisions of a life, are to man the accommodations of a journey. In the one we singly behold the indications of a divine benevolence. With the other, we connect the purposes of a divine administration; and besides the love and liberality of a Parent, we recognise the designs of a Teacher, and Governor, and Judge.

7. And these special affections, though their present and more conspicuous use be to uphold the existing economy of life, are not without their influence and their uses in a system of moral discipline. And it is quite obvious, that, ere we can pronounce on the strict and essential virtuousness of any human being, they must be admitted into the reckoning. In estimating the precise moral quality of any beneficence which man may have executed, it is indispensable to know, in how far he was schooled into it at the bidding of principle, and in how far urged forward to it by the impulse of a special affection. To do good to another because he feels that he ought, is an essentially distinct exhibition from doing the same good, by the force of parental love, or of an instinctive and spontaneous compassion—as distinct as the strength of a constitutionally implanted desire is from the sense of a morally incumbent obligation. In as far as I am prompted to the relief of distress, by a movement of natural pity—in so far less is left for virtue to do. In as far as I am restrained from the out-breakings of an anger which tumultuates within, by the dread of a counter-resentment and retaliation from without—in

so far virtue has less to resist. It is thus that the special affections may at once lighten the tasks and lessen the temptations of virtue; and, whether in the way of help at one time or of defence at another, may save the very existence of a principle, which in its own unaided frailty, might, among the rude conflicts of life, have else been overborne. It is perhaps indispensable to the very being of virtue among men, that, by means of the special affections, a certain force of inclination has been superadded to the force of principle—we doubt not, in proportions of highest wisdom, of most exquisite skill and delicacy. But still the strength of the one must be deducted, in computing the real strength of the other; and so the special affections of our nature not only subserve a purpose in time, but are of essential and intimate effect in the processes of our moral preparation, and will eventually tell on the high retributions and judgments of eternity.

8. Man is not a utilitarian either in his propensities or in his principles. When doing what he likes—it is not always, it is not generally, because of its perceived usefulness, that he so likes it. But his inclinations, these properties of his nature, have been so adapted both to the material world and to human society, that a great accompanying or great resulting usefulness, is the effect of that particular constitution which God hath given to him. And when doing what he feels that he ought, it is far from always because of its perceived usefulness, that he so feels. But God hath so formed our mental constitution, and hath so adapted the whole economy of external things to the stable and everlasting principles of virtue, that, in effect and historical fulfilment, the greatest virtue and the greatest happiness are at one. But the union of these two does not constitute their unity. Virtue is not right, because it is useful; but God hath made it useful, because it is right. He both loves virtue, and wills the happiness of his creatures—this benevolence of will, being itself, not the whole, but one of the brightest moralities in the character of the Godhead. He wills the happiness of man, but wills his virtue more; and accordingly, hath so constructed both the system of humanity, and the system of external nature, that, only through the medium of virtue, can any substantial or lasting happiness be realised. The utilitarians have confounded these two elements, because of the inseparable yet contingent alliance, which a God of virtue hath established between them. The Cosmopolites are for merging all the particular affections into one; and would substitute in their place a general desire for the greatest possible amount of good to others, as the alone guide and impellent of human conduct. And the Utilitarians are for merging all the particular virtues into one; and would substitute in their place the greatest usefulness, as the alone principle to which every question respecting the morality of actions should be referred. The former would do away friendship, and patriotism, and all the partialities or even in-

instincts of relationship, from the system of human nature. The latter would at least degrade, if not do away, truth and justice from the place which they now hold in the system of Ethics. The desolating effect of such changes on the happiness and security of social life, would exhibit the vast superiority of the existent economy of things, over that speculative economy into which these theorists would transform it; or, in other words, would prove by how mighty an interval, the goodness and the wisdom of God transcended both the goodness and the wisdom of man.

9. The whole of this speculation, if followed out into its just and legitimate consequences, would serve greatly to humble and reduce our estimate of human virtue. Nothing is virtuous, but what is done under a sense of duty; or done, simply and solely because it ought. It is only in as far as this consideration is present to the mind, and is of practical and prevalent operation there—that man can be said to feel virtuously, or to act virtuously. We should not think of affixing this moral characteristic to any performance however beneficial, that is done under the mere impulse of a headlong sensibility, without any sense or any sentiment of a moral obligation. In every good action, that is named good because useful to society, we should subduct or separate all which is due to the force of a special affection, that we might precisely ascertain how much or how little remains, which may be due to the force of principle. The inferior animals, destitute though they be of a moral nature and therefore incapable of virtue, share with us in some of the most useful and amiable instincts which belong to humanity; and when we stop to admire the workings of nature's sensibility—whether in the tears that compassion sheds over the miseries of the unfortunate, or in the smiles and endearments which are lavished by a mother upon her infant family, we seldom reflect how little of the real and proper character of virtue is there. We accredit man, as if they were his own principles, with those instincts which the divinity hath implanted within him; and it aggravates the error, or rather the guilt of so perverse a reckoning—that, while we offer this incense to humanity, we forget all the while the hand of Him, by whom it is that humanity is so bountifully gifted and so beautifully adorned.

CHAPTER IX.

Miscellaneous Evidences of virtuous and benevolent Design, in the Adaptation of External Nature to the Moral Constitution of Man.

1. It will be enough, if, after having led the way on a new territory of investigation, we shall select one or two out of the goodly number of instances, as specimens of the richness and fertility of the land. We have already endeavoured to prove, why a number of distinct benefits, even though reducible by analysis into one principle or law, still affords not a solitary, but a multiple of evidence, of the wise and benevolent Creator.* This evidence, in fact, is proportioned to the number, not of efficient but final causes in nature—so that each separate example of a good rendered to humanity, in virtue of its actual constitution, may be regarded as a separate and additional evidence, of its having been formed by an artificer, at once of intelligent device and kind purposes. The reduction of these examples into fewer laws does not extenuate the argument for His goodness; and it may enhance the argument for His wisdom.

2. The first instance which occurs to us is that law of affection, by which its intensity or strength is proportioned to the helplessness of its object. It takes a direction downwards; descending, for example, with much greater force from parents to children, than ascending from children to parents back again—save when they lapse again into second infancy, and the duteous devoted attendance by the helpful daughters of a family, throughout the protracted ailments and infirmity of their declining years, instead of an exception, is in truth a confirmation of the law—as much so, as the stronger attraction of a mother's heart towards the youngest of the family; or, more impressive still, her more special and concentrated regard towards her sickly or decrepit or even idiot boy. It is impossible not to recognise in this beautiful determination of nature, the benevolence of nature's God.

3. Such instances could be greatly multiplied; and we invite the future explorers of this untrodden field to the task of collecting them. We hasten to instances of another kind, which we all the more gladly seize upon, as being cases of purest and strictest adaptation, not of the external mental, but of the external material world, to the moral constitution of man.

4. The power of speech is precisely such an adaptation. Whether we regard the organs of utterance and hearing in man, or the aerial medium by which sounds are conveyed—do we behold a pure subserviency of the material to the mental system of our

* Introductory Chapter. Art. 27, 28, 29.

world. It is true that the great object subserved by it, is the action and reaction between mind and mind—nor can we estimate this object too highly, when we think of the mighty influence of language, both on the moral and intellectual condition of our species. Still it is by means of an elaborate material construction that this pathway has been formed, from one heart and from one understanding to another. And therefore it is, that the faculty of communication by words, with all the power and flexibility which belong to it, by which the countless benefits of human intercourse are secured, and all the stores of sentiment and thought are turned into a common property for the good of mankind, may well be ranked among the highest of the examples that we are now in quest of—it being indeed as illustrious an adaptation as can be named of External Nature to the Moral and Intellectual Constitution of Man. Of the converse of disembodied spirits we know nothing. But to man cased in materialism, certain material passages or ducts of conveyance, for the interchange of thought and feeling between one mind and another seem indispensable. The exquisite provision which has been made for these, both in the powers of articulation and hearing, as also in that intermediate element, by the pulsations of which ideas are borne forward, as on so many winged messengers from one intellect to another—bespeaks, and perhaps more impressively than any other phenomena in nature, the contrivance of a supreme artificer, the device and finger of a Deity.*

5. But articulate and arbitrary sound is not the only vehicle, either of meaning or sentiment. There is a natural as well as artificial language, consisting chiefly of expressive tones—though greatly reinforced both by expressive looks and expressive gestures. The voice, by its intonations alone, is a powerful instrument for the propagation of sympathy between man and man; and there is similarity enough between us and the inferior animals, in the natural signs of various of the emotions, as anger and fear and grief and cheerfulness, for the sympathy being extended beyond the limits of our own species, and over a great part of the sentient creation. We learn by experience and association the significancy of the merely vocal apart from vocables; for almost each shade of meaning, at least each distinct sensibility, has its own appropriate intonation—so that, without catching one syllable of the utterance, we can, from its melody alone, often tell what are the workings of the heart, and even what are the workings of the intellect. It is thus that music, even though altogether apart from words, is so powerfully fitted,

* It will at once be seen that the same observations may be extended to written language, and to the fitness of those materials which subserve through its means, the wide and rapid communication of human thoughts. We in truth could have multiplied indefinitely such instances of adaptation as we are now giving—but we judge it better to have confined ourselves throughout the volume, to matters of a more rudimental and general character—leaving the manifold detail and fuller developments of the argument to future labourers in the field.

both to represent and to awaken the mental processes—inasmuch that, without the aid of spoken characters, many a story of deepest interest is most impressively told, many a noble or tender sentiment is most emphatically conveyed by it. It says much for the native and original predominance of virtue—it may be deemed another assertion of its designed pre-eminence in the world, that our best and highest music is that which is charged with loftiest principle, whether it breathes in orisons of sacredness, or is employed to kindle the purposes and to animate the struggles of resolved patriotism; and that never does it fall with more exquisite cadence on the ear of the delighted listener, than when attuned to the home sympathies of nature, it tells in accents of love or pity, of its woes and its wishes for all humanity. The power and expressiveness of music may well be regarded as a most beautiful adaptation of external Nature to the Moral Constitution of Man—for what can be more adapted to his moral constitution, than that which is so helpful as music eminently is, to his moral culture? Its sweetest sounds are those of kind affection. Its sublimest sounds are those most expressive of moral heroism; or most fitted to solemnize the devotions of the heart, and prompt the aspirations and resolves of exalted piety.

6. A philosophy of taste has been founded on this contemplation; and some have contended that both the beauty and the sublimity of sounds are derived from their association with moral qualities alone. Without affirming that association is the only, or the universal cause, it must at least be admitted to have a very extensive influence over this class of our emotions. If each of the mental affections have its own appropriate intonation; and there be the same or similar intonations given forth, either by the inanimate creation or by the creatures having life which are inferior to man—then, frequent and familiar on every side of him, must be many of those sounds by which human passions are suggested, and the memory of things awakened which are fitted to affect and interest the heart. And thus it is, that, to the ear of a poet, all nature is vocal with sentiment; and he can fancy a genius or residing spirit, in the ocean, or in the tempest, or in the rushing waterfall, or in the stream whose softer murmurs would lull him to repose—or in the mighty forest, when he hears the general sigh emitted by its innumerable leaves as they rustle in the wind, and from whose fitful changes he seems to catch the import of some deep and mysterious soliloquy. But the imagination will be still more readily excited by the notes and the cries of animals, as when the peopled grove awakens to harmony; or when it is figured, that, amid the amplitudes of savage and solitary nature, the lioness robbed of her whelps, calls forth the echoes of the wilderness—making it to ring with the proclamation of her wrongs. But, without conceiving any such rare or extreme sensibility as this, there is a common, an every-day enjoyment which all have in the sounds

of nature; and as far as sympathy with human emotions is awakened by them, and this forms an ingredient of the pleasure, it affords another fine example, of an adaptation in the external world to the mental constitution of its occupiers.

7. But the same philosophy has been extended to sights as well as sounds. The interchange of mind with mind is not restricted to language. There is an interchange by looks also; and the ever-varying hues of the mind are represented, not by the complexion of the face alone or the composition of its features, but by the attitude and gestures of the body.* It is thus that human sentiment or passion may come to be expressed by the colour and form and even the motion of visible things; by a kindred physiognomy for all the like emotions on the part of the inferior animals—nay, by a certain countenance or shape in the objects of mute and unconscious nature. It is thus that a moral investment sits on the aspects of the purely material world; and we accordingly speak of the modesty of the violet, the innocence of the lily, the commanding mountain, the smiling landscape. Each material object has its character, as is amply set forth in the beautiful illustrations of Mr. Alison; and so to the poet's eye, the whole panorama of nature is one grand personification, lighted up throughout by consciousness and feeling. This is the reason why in all languages, material images and moral characteristics are so blended and identified. It is the law of association which thus connects the two worlds of sense and of sentiment. Sublimity in the one is the counterpart to moral greatness in the other; and beauty in the one is the counterpart to moral delicacy in the other. Both the graceful and the grand of human character are as effectually embodied in the objects and scenery of nature, as in those immortal forms which have been transmitted by the hand of sculptors to the admiration of distant ages. It is a noble testimony to the righteousness of God, that the moral and the external loveliness are thus harmonized—as well as to the wisdom which has so adapted the moral and the material system to each other, that supreme virtue and supreme beauty are at one.

“Mind, mind alone, bear witness earth and heaven!
The living fountain, in itself contains
Of beauteous and sublime.
There hand in hand sit paramount the graces;
There enthroned, celestial Venus with divinest airs
Invites the soul to never fading joy.”

AKENSIDE.

* We may here state that as the air is the medium by which sounds are conveyed—so light may be regarded as standing in the same relation to those natural signs whether of colour, gesture or attitude, which are addressed to the eye. Much could be said respecting the adaptation of light to the moral constitution of man—arising from the power which the very observation of our fellow-men has in repressing, so long as we are under it, indecency or crime. The works of iniquity are called works of darkness.

8. And we may here remark a certain neglect of external things and external influences, which, however enlightened or transcendently rational it may seem, is at variance with truth of principle and sound philosophy. We should instance the undervaluing of the natural signs in eloquence, although their effect makes all the difference in point of impression and power between spoken and written language—seeing that, superadded to articulate utterance, the eye and the intonations and the gestures also serve as so many signals of conveyance for the transmission of sentiment from one mind to another. It is thus that indifference to manner or even to dress, may be as grievous a dereliction against the real philosophy of social intercourse—as indifference to the attitude and the drapery of figures would be against the philosophy of the fine arts. Both proceed on the forgetfulness of that adaptation, in virtue of which materialism is throughout instinct with principle, and both in its colouring and forms, gives forth the most significant expressions of it. On this ground too we would affirm, both of state ceremonial and professional costume, that neither of them is insignificant; and that he who in the spirit of rash and restless innovation would upset them, as if they were the relics of a gross and barbaric age, may be doing violence not only to the usages of venerable antiquity, but to the still older and more venerable constitution of human nature—weakening in truth the bonds of social union, by dispensing with certain of those influences which the Great Author of our constitution designed for the consolidation and good order of society. This is not accordant with the philosophy of Butler, who wrote on the “use of externals in matters of religion,”—nor with the philosophy of those who prefer the findings of experience, however irreducible to system they may be, to all the subtleties or simplifications of unsupported theory.*

9. Before quitting this subject, we remark, that it is no proof against the theory which makes taste a derivative from morality, that our emotions of taste may be vivid and powerful, while our principles of morality are so weak as to have no ascendant or governing influence over the conduct. This is no unusual phenomenon of our mysterious nature. There is a general homage rendered to virtue in the world; but it is the homage, more of a dilettanti than of an obedient and practical devotee. This is not more surprising, than that the man of profligate habits should have a tasteful admiration of sacred pictures and sacred melodies; or that, with the heart of a coward, he should nevertheless catch the glow of at least a momentary inspiration from the music of war and patriotism. It seems the effect and evidence of some great moral derangement, that there should be such an incongruity in subjective man between his taste

* The perusal of those works which treat scientifically of the fine arts, as Sir Joshua Reynolds' Discourses, is well adapted to rebuke and rectify the light estimation, in which all sensible accompaniments are apt to be held by us.

and his principles; and the evidence is not lessened but confirmed, when we observe a like incongruity in the objective nature by which he is surrounded—we mean, between the external mental and external material world. We have only to open our eyes and see how wide, in point of loveliness, the contrast or dissimilarity is, between the moral and the material of our actual contemplation—the one coming immediately from the hand of God; the other tainted and transformed by the spirit of man. We believe with Alison and others, that, to at least a very great extent, much of the beauty of visible things lies in association; that it is this which gives its reigning expression to every tree and lake and waterfall, and which may be said to have impregnated with character the whole of the surrounding landscape. How comes it then, that, in the midst of living society, where we might expect to meet with the originals of all this fascination, we find scarcely any other thing than a tame and uninteresting level of the flat and the sordid and the ordinary—whereas, in that inanimate scenery, which yields but the faint and secondary reflection of moral qualities, there is, on every line and on every feature, so vivid an impress of loveliness and glory? One cannot go forth of the crowded city to the fresh and the fair of rural nature, without the experience, that, while in the moral scene, there is so much to thwart and to revolt and to irritate—in the natural scene, all is gracefulness and harmony. It reminds us of the contrast which is sometimes exhibited, between the soft and flowery lawn of a cultivated domain, and the dark or angry spirit of its owner—of whom we might almost imagine, that he scowls from the battlements of his castle, on the intrusion of every unlicensed visiter. And again the question may be put—whence is it that the moral picturesque in our world of sense, as it beams upon us from its woods and its eminences and its sweet recesses of crystal stream or of grassy sunshine, should yield a delight so unqualified—while the primary moral characteristics, of which these are but the imagery or the visible representation, should, in our world of human spirits, be so wholly obliterated, or at least so woefully deformed? Does it not look as if a blight had come over the face of our terrestrial creation, which hath left its materialism in a great measure untouched, while it has inflicted on man a sore and withering leprosy? Do not the very openness and benignity which sit on the aspect of nature reproach him, for the cold and narrow and creeping jealousies that be at work in his own suspicious bosom; and most impressively tell the difference between what man is, and what he ought to be?

10. There are certain other adaptations; but on which we forbear to expatiate.* Some of them indeed border on a territory distinct

* It must be obvious that we cannot exhaust the subject, but only *exemplify* it, by means of a few specimens. There is an adaptation, which, had it occurred in time, might have been stated in the text—suggested by the celebrated question respecting the liberty of the human will. We cannot but admit how much it would

from our own, if they do not altogether belong to it. The relation between food and hunger, between the object and the appetite, is an instance of the adaptation between external nature and man's physical constitution—yet the periodical recurrence of the appetite itself, with its imperious demand to be satisfied, viewed as an impellent to labour even the most irksome and severe, has an important effect both on the moral constitution of the individual and on the state of society. The superficies of the human body, in having been made so exquisitely alive at every pore to the sensations of pain, may be regarded as nature's defensive covering against those exposures from without, which else might injure or destroy it. This is purely a physical adaptation, but it involves a moral adaptation also; for this shrinking and sensitive avoidance, at the first approaches of pain affords a similar protection against certain hazards from within—as self-mutilation in the moment of the spirit's wantonness, or even self-destruction in the moment of its despair. But, without enlarging further on specific instances, we shall now advert to one subject, furnished by the history of moral science; and replete, we have long thought, with the materials of a very strong and comprehensive argument.

11. We have already adverted to the objective nature of virtue, and the subjective nature of man, as forming two wholly distinct objects of contemplation. It is the latter and not the former which indicates the moral character of God. The mere system of ethical doctrine is no more fitted to supply an argument of this character, than would the system of geometry. It is not geometry in the abstract, but geometry as embodied in the heavens, or in the exquisite

have deteriorated the constitution of humanity, or rather destroyed one of its noblest and most essential parts, had it been so constructed, as that either man was not accountable for his own actions, or that these actions were free in the sense contended for by one of the parties in the controversy—that is, were so many random contingencies which had no parentage in any events or influences that went before them, or occupied no place in a train of causation. Of the reasoners on the opposite sides of this sorely agitated question—the one contending for the moral liberty, and the other for the physical necessity of human actions—it is clear that there are many who hold the one to be destructive of the other. But what the wisdom of man cannot argumentatively harmonize in the world of speculation, the power and wisdom of God have executively harmonized in the world of realities—so that man, on the one hand, irresistibly feels himself to be an accountable creature; and yet, on the other, his doings are as much the subject of calculation and of a philosophy, as many of those classes of phenomena in the material world, which, fixed and certain in themselves, are only uncertain to us, not because of their contingency, but because of their complication. We are not sure if the evolutions of the will are more beyond the reach of prediction than the evolutions of the weather. It is this union of the moral character with the historical certainty of our volitions, which has proved so puzzling, to many of our controversialists; but in proportion to the difficulty felt by us in the adjustment of these two elements, should be our admiration of that profound and exquisite skill which has mastered the apparent incongruity—so that while every voluntary action of man is, in point of reckoning, the subject of a moral, it is, in point of result, no less the subject of a physical law.

structures of the terrestrial physics—which bespeaks the skill of the artificer who framed them. In like manner it is not moral science in the abstract—but the moral constitution of beings so circumstanced and so made, that virtue is the only element in which their permanent individual or social happiness can be realized, which bespeaks the great Parent of the human family to be Himself the lover and the exemplar of righteousness. In a word, it is not from an abstraction, but from the facts of a creation, that our lesson respecting the divine character, itself a fact, is to be learned; and it is by keeping this distinction in view, that we obtain one important help for drawing from the very conflict and diversity of moral theories on the nature of virtue, a clear, nay a cumulative argument for the virtuous nature of the Godhead.

12. The painful suspicion is apt to intrude upon us, that virtue may not be a thing of any substance or stability at all—when we witness the confusion and the controversy into which moralists have fallen, on the subject of its elementary principles. But, to allay this feeling, it should be observed, in the first place, that, with all the perplexity which obtains on the question of what virtue, in the abstract or in its own essential and constituting quality, is—there is a pretty general agreement among moralists, as to what the separate and specific virtues of the human character are. According to the selfish system, temperance may be a virtue, because of its subservience to the good of the individual; while by the system of utility it is a virtue, because through its observation, our powers and services are kept entire for the good of society. But again, beside this controversy which relates to the nature of virtue in itself, and which may be termed the objective question in morals—there is a subjective or an organic question which relates, not to the existence, but to the origin and formation of the notion or feeling of virtue in the human mind. The question, for example, whether virtue be a thing of opinion or a thing of sentiment, belongs to this class. Now, in regard to all those questions which respect the origin or the pedigree of our moral judgments, it should not be forgotten, that, while the controvertists are at issue upon this, they are nearly unanimous, as to morality itself being felt by the mind as a matter of supreme obligation. They dispute about the moral sense in man, or about the origin and constitution of the court of conscience; but they have no dispute about the supreme authority of conscience—even as, in questions of civil polity and legislation, there may be no dispute about the rightful authority of some certain court, while there may be antiquarian doubts and differences on the subjects of its origin and formation. Dr. Smith, for example, while he has his own peculiar views on the origin of our moral principles, never questions their authority. He differs from others, in regard to the rationale, or the anterior steps of that process, which at length terminates in a decision of the mind, on the merit or demerit of a particular ac-

tion. The rightness and the supremacy of that decision are not in the least doubted by him. There may be a metaphysical controversy about the mode of arriving at our moral judgment, and at the same time a perfect concurrence in it as the guide and the regulator of human conduct—just as there may be an anatomical controversy about the structure of the eye or the terminations of the optic nerve, and a perfect confidence with all parties, in the correctness of those intimations which the eye gives, of the position of external objects and their visible properties. By attending to this we obtain a second important help for eliciting from the diversity of theories on the nature of virtue, a cumulative argument for the virtuous nature of the Godhead.

13. When the conflict then of its opposing theories, would seem to bring fearful insecurity on moral science, let it not be forgotten, that the very multitude of props and securities, by which virtue is upholden, is that which has given rise to the conflict. There is little or no scepticism, in regard to the worth or substantive being of morality, but chiefly in regard to its sustaining principle; and it is because of so much to sustain it, or of the many distinct and firm props which it rests upon, that there has been such an amount of ethical controversy in the world. There has been many a combat, and many a combatant—not because of the baselessness of morality, but because it rests on a basis of so many goodly pillars, and because of such a varied convenience and beauty in the elevation of the noble fabric. The reason of so much controversy is, that each puny controversialist, wedded to his own exclusive view of an edifice too mighty and majestic for his grasp, has either selected but one of the upholding props, and affirmed it to be the only support of the architecture; or attended to but one of its graces and utilities, and affirmed it to be the alone purpose of the magnificent building. The argument of each, whether on the foundation of virtue or on its nature, when beheld aright, will be found a distinct trophy to its worth—for each can plead some undoubted excellence or good effect of virtue in behalf of his own theory. Each may have so magnified the property which himself had selected—as that those properties of virtue which others had selected, were thrown into the shade, or at most but admitted as humble attendants, in the retinue of his own great principle. And so, the controversy is not, whether morality be a solidly constituted fabric; but what that is which constitutes its solidity, and which should be singled out as the keystone of the fabric. Each of the champions in this warfare has fastened on a different keystone; and each pushes the triumph against his adversary by a demonstration of its firmness. Or in other words, virtue is compassed about with such a number of securities, and possesses such a superabundance of strength, as to have given room for the question that was raised about Samson of old—what that is wherein its great strength lies. It is like the controversy which

sometimes arises, about a building of perfect symmetry—when sides are taken, and counter-explanations are advanced and argued, about the one characteristic or constituting charm, which hath conferred upon it so much gracefulness. It is even so of morality. Each partisan hath advocated his own system; and each, in doing so, hath more fully exhibited some distinct property or perfection of moral rectitude. Morality is not neutralized by this conflict of testimonies; but rises in statelier pride, and with augmented security, from the foam and the turbulence which play around its base. To her this conflict yields, not a balance, but a summation of testimonies; and, instead of an impaired, it is a cumulative argument, that may be reared out of the manifold controversies to which she has given rise. For when it is asserted by one party in the strife, that the foundation of all morality is the right of God to the obedience of his creatures—let God's absolute right be fully conceded to them. And when others reply, that, apart from such right, there is a native and essential rightness in morality, let this be conceded also. There is indeed such a rightness, which, anterior to law, hath had everlasting residence in the character of the Godhead; and which prompted him to a law, all whose enactments bear the impress of purest morality. And when the advocates of the selfish system affirm, that the good of self is the sole aim and principle of virtue; while we refuse their theory, let us at least admit the fact to which all its plausibility is owing—that nought conduces more surely to happiness, than the strict observation of all the recognised moralities of human conduct. And when a fourth party affirms that nought but the useful is virtuous; and, in support of their theory, can state the unvarying tendencies of virtue in the world towards the highest good of the human family—let it forthwith be granted, that the same God, who blends in his own person, both the rightness of morality and the right of law, that He hath so devised the economy of things and so directs its processes, as to make peace and prosperity follow in the train of righteousness. And when the position that virtue is its own reward, is cast as another dogma into the whirlpool of debate, let it be fondly allowed, that the God, who delights in moral excellence himself, hath made it the direct minister of enjoyment to him, who, formed after his own image, delights in it also. And when others, expatiating on the beauty of virtue, would almost rank it among the objects of taste rather than of principle—let this be followed up by the kindred testimony, that, in all its exhibitions, there is indeed a supreme gracefulness; and that God, rich and varied in all the attestations which He has given of his regard to it, hath so endowed His creatures, that, in moral worth, they have the beatitudes of taste as well as the beatitudes of conscience. And should there be philosophers who say of morality that it is wholly founded upon the emotions—let it at least be granted, that He whose hand did frame our internal mechanism, has at-

tuned it in the most correct and delicate correspondency, with all the moralities of which human nature is capable. And should there be other philosophers who affirm that morality hath a real and substantive existence in the nature of things, so as to make it as much an object of judgment distinct from him who judges, as are the eternal and immutable truths of geometry—let it with gratitude be acknowledged that the mind is so constituted as to have the same firm hold of the moral which it has of the mathematical relations; and if this prove nothing else, it at least proves, that the Author of our constitution hath stamped there, a clear and legible impress on the side of virtue. We should not exclude from this argument even the degrading systems of Hobbes and Mandeville; the former representing virtue as the creation of human policy, and the latter representing its sole principle to be the love of human praise—for even they tell thus much, the one that virtue is linked with the well-being of the community, the other that it has an echo in every bosom. We would not dissever all these testimonies; but bind them together into the sum and strength of a cumulative argument. The controversialists have lost themselves, but it is in a wilderness of sweets—out of which the materials might be gathered, of such an incense at the shrine of morality, as should be altogether overpowering. Each party hath selected but one of its claims; and, in the anxiety to exalt it, would shed a comparative obscurity over all the rest. This is the contest between them—not whether morality be destitute of claims; but what, out of the number that she possesses, is the great and pre-eminent claim on which man should do her homage. Their controversy perhaps never may be settled; but to make the cause of virtue suffer on this account, would be to make it suffer from the very force and abundance of its recommendations.

14. But this contemplation is pregnant with another inference, beside the worth of virtue—even the righteous character of Him, who, for the sake of upholding it hath brought such a number of contingencies together. When we look to the systems of utility and selfishness, let us look upwardly to Him, through whose ordination alone it is, that virtue hath such power to prosper the arrangements of life and of society. Or when told of the principle that virtue is its own reward, let us not forget him who so constituted our moral nature, as to give the feeling of an exquisite charm, both in the possession of virtue and in the contemplation of it. Or when the theory of a moral sense offers itself to our regards, let us bear regard along with it to that God, who constructed this organ of the inner man, and endowed it with all its perceptions and all its feelings. In the utility wherewith He hath followed up the various observations of moral rectitude; in the exquisite relish which he hath infused into the rectitude itself; in the law of conformity thereto which he hath written on the hearts of all men; in the aspect of eternal and unchangeable fitness, under which He hath made it manifest to every conscience—in these, we behold the elements of

many a controversy, on the nature of virtue; but in these, when viewed aright, we also behold a glorious harmony of attestations to the nature of God. It is thus that the perplexities of the question, when virtue is looked to as but a thing of earthly residence, are all done away, when we carry the speculation upward to heaven. They find solution there; and cast a radiance over the character of Him who hath not only established in righteousness His throne, but, by means of a rich and varied adaptation, hath profusely shed over the universe that He hath formed, the graces by which He would adorn, and the beatitudes by which He would reward it.

15. Although the establishment of a moral theory is not now our proper concern, we may nevertheless take the opportunity of expressing our dissent from the system of those, who would resolve virtue, not into any native or independent rightness of its own, but unto the will of Him who has a right to all our services. Without disparagement to the Supreme Being, it is not His law which constitutes virtue; but, far higher homage both to Him and to His law the law derives all its authority and its being from a virtue of anterior residence in the character of the Divinity. It is not by the authority of any law over Him, that truth and justice and goodness and all the other perfections of supreme moral excellence, have, in His person, had their everlasting residence. He had a nature, before that He uttered it forth into a law. Previous to creation, there existed in His mind, all those conceptions of the great and the graceful, which He hath embodied into a gorgeous universe; and of which every rude sublimity of the wilderness, or every fair and smiling landscape, gives such vivid representation. And in like manner, previous to all government, there existed in His mind, those principles of righteousness, which afterwards, with the right of an absolute sovereign, He proclaimed into a law. Those virtues of which we now read on a tablet of jurisprudence were all transcribed and taken off from the previous tablet of the divine character. The law is but a reflection of this character. In the fashioning of this law, He pictured forth Himself; and we, in the act of observing His law, are only conforming ourselves to His likeness. It is there that we are to look for the primeval seat of moral goodness. Or, in other words, virtue has an inherent character of her own—apart from law, and anterior to all jurisdiction.

16. Yet the right of God to command, and the rightness of His commandments, are distinct elements of thought, and should not be merged into one another. We should not lose sight of the individuality of each, nor identify these two things—because, instead of antagonists, they do in fact stand side by side, and act together in friendly co-operation. Because two influences are conjoined in agency, that is no reason why they should be confounded in thought. Their union does not constitute their unity—and though, in the conscience of man, there be an approbation of all rectitude; and all

rectitude, be an obligation laid upon the conduct of man by the divine law—yet still, the approbation of man's moral nature is one thing, and the obligation of God's authority is another.

17. That there is an approval of rectitude, apart from all legal sanctions and legal obligations, there is eternal and unchangeable demonstration in the character of God Himself. He is under no law, and owns the authority of no superior. It is not by the force of sanctions, but by the force of sentiments that the divinity is moved. Morality with Him is not of prescription, but of spontaneous principle alone; and He acts virtuously, not because He is bidden; but because virtue hath its inherent and eternal residence in His own nature. Instead of deriving morality from law, we should derive law, even the law of God, from the primeval morality of His own character; and so far from looking upwardly to His law as the fountain of morality, do we hold it to be the emanation from a higher fountain that is seated in the depths of His unchangeable essence, and is eternal as the nature of the Godhead.

18. The moral hath antecedency over the juridical, God acts righteously, not because of jurisdiction by another, but because of a primary and independent justice in Himself. It was not law which originated the moralities of the divine character; but these moralities are self-existent and eternal as is the being of the Godhead. The virtues had all their dwelling-place in the constitution of the Divinity—ere He stamped the impress of them on a tablet of jurisprudence. There was an inherent, before there was a preceptive morality; and righteousness, and goodness, and truth, which all are imperative enactments of law, were all prior characteristics, in the underived and uncreated excellence of the Lawgiver.

CHAPTER X.

On the capacities of the World for making a virtuous Species happy; and the Argument deducible from this, both for the character of God, and the Immortality of Man.

1. WE have already stated the distinction, between the theology of those, who would make the divine goodness consist of all moral excellence; and of those, who would make it consist of benevolence alone. Attempts have been made to simplify the science of morals, by the reduction of its various duties or obligations into one element—as when it is alleged, that the virtuousness of every separate morality is reducible into benevolence, which is regarded as the central, or as the great master and generic virtue that is comprehensive of

them all. There is a theoretic beauty in this imagination—yet it cannot be satisfactorily established, by all our powers of moral or mental analysis. We cannot rid ourselves of the obstinate impression, that there is a distinct and native virtuousness, both in truth and in justice, apart from their subserviency to the good of men; and accordingly, in the ethical systems of all our most orthodox expounders, they are done separate homage to—as virtues standing forth in their own independent character, and having their own independent claims both on the reverence and observation of mankind. Now, akin with this attempt to generalise the whole of virtue into one single morality, is the attempt to generalise the character of God into one single moral perfection. Truth and justice have been exposed to the same treatment, in the one contemplation as in the other—that is, regarded more as the derivatives from the higher characteristic of benevolence, than as distinct and primary characteristics themselves. The love of philosophic simplicity may have led to this in the abstract or moral question; but something more has operated in the theological question. It falls in with a still more urgent affection than the taste of man; it falls in with his hope and his sense of personal interest, that the truth and justice of the Divinity should be removed, as it were, to the back-ground of this perspective. And accordingly, this inclination to soften, if not to suppress, the sterner affections of righteousness and holiness, appears, not merely in the pleasing and poetic effusions of the sentimental, but also in the didactic expositions of the academic theism. It is thus that Paley, so full and effective, and able in his demonstrations of the natural, is yet so meagre in his demonstrations of the moral attributes. It is, in truth, the general defect, not of natural theology in itself—but of natural theology, as set forth at the termination of ethical courses, or as expounded in the schools. In this respect, the natural theology of the heart, is at variance, with the natural theology of our popular and prevailing literature. The one takes its lesson direct from conscience, which depones to the authority of truth and justice, as distinct from benevolence; and carries this lesson upwards, from that tablet of virtue which it reads on the nature of man below, to that higher tablet upon which it reads the character of God above. The other again, of more lax and adventurous speculation, would fain amalgamate all the qualities of the Godhead into one; and would make that one the beautiful and undistinguishing quality of tenderness. It would sink the venerable or the awful into the lovely; and to this it is prompted, not merely for the sake of theoretic simplicity—but in order to quell the alarms of nature, the dread and the disturbance which sinners feel, when they look to their sovereign in heaven, as a God of judgment and of unspotted holiness. Nevertheless the same conscience which tells what is sound in ethics, is ever and anon suggesting what is sound in theology—that we have to do with a God of truth, that we have to do

with a God of righteousness; and this lesson is never perhaps obliterated in any breast, by the imagery, however pleasing, of a universal parent, throned in soft and smiling radiance, and whose supreme delight is to scatter beatitudes innumerable through a universal family. We cannot forget, although we would, that justice and judgment are the habitation of His throne; and that His dwelling-place is not a mere blissful elysium or paradise of sweets, but an august and inviolable sanctuary. It is an elysium, but only to the spirits of the holy; and this sacredness, we repeat, is immediately forced upon the consciousness of every bosom, by the moral sense which is within it—however fearful a topic it may be of recoil to the sinner, and of *reticence* in the demonstrations of philosophy. The sense of heaven's sacredness is not a superstitious fear. It is the instant suggestion of our moral nature. What conscience apprehends virtue to be in itself, that also it will apprehend virtue to be in the Author of conscience; and if truth and justice be constituent elements in the one, these it will regard as constituent elements in the other also. It is by learning direct of God from the phenomena of human conscience; or taking what it tells us to be virtues in themselves, for the very virtues of the Godhead, realised in actual and living exemplification upon His character—it is thus that we escape from the illusion of poetical religionists, who, in the incense which they offer to the benign virtues of the parent, are so apt to overlook the virtues of the Lawgiver and Judge.

2. When we take this fuller view of God's moral nature—when we make account of the righteousness as well as the benevolence—when we yield to the suggestion of our own hearts, that to Him belongs the sovereign state, and, if needful, the severity of the lawgiver, as well as the fond affection of the parent—when we assign to Him the character, which, instead of but one virtue, is comprehensive of them all—we are then on firmer vantage-ground for the establishment of a natural Theology, in harmony, both with the lessons of conscience, and with the phenomena of the external world. Many of our academic theists have greatly crippled their argument, by confining themselves to but one feature in the character of the Divinity—as if His only wish in reference to the creatures that He had made, was a wish for their happiness; or as if, instead of the subjects of a righteous and moral government, they were but the nurslings of His tenderness. They have exiled and put forth everything like jurisprudence from the relation in which God stands to man; and by giving the foremost place in their demonstrations to the mere beneficence of the Deity, they have made the difficulties of the subject far more perplexing and unresolvable than they needed to have been. For with benevolence alone we cannot even extenuate and much less extricate ourselves, from the puzzling difficulty of those physical sufferings to which the sentient creation, as far as our acquaintance extends with it, is universally liable. It is only by

admitting the sanctities along with what may be termed the humanities of the divine character, that this enigma can be at all alleviated. Whereas, if, apart from the equities of a moral government, we look to God in no other light, than mere tasteful and sentimental religionists do, or as but a benign and indulgent Father whose sole delight is the happiness of his family—there are certain stubborn anomalies which stand in the way of this frail imagination, and would render the whole subject a hopeless and utterly intractable mystery.

3. A specimen of the weakness which attaches to the system of Natural Theology, when the infinite benevolence of the Deity is the only element which it will admit into its explanations and its reasonings, is the manner in which its advocates labour to dispose of the numerous ills, wherewith the world is infested. They have recourse to arithmetic—balancing the phenomena on each side of the question, as they would the columns of a ledger. They institute respective summations of the good and the evil; and by the preponderance of the former over the latter, hold the difficulty to be resolved. The computation is neither a sure nor an easy one; but even under the admission of its justness, it remains an impracticable puzzle—why under a Being of infinite power and infinite benevolence, there should be suffering at all. This is an enigma which the single attribute of benevolence cannot unriddle, or rather the very enigma which it has created—nor shall we even approximate to the solution of it, without the aid of other attributes to help the explanation.

4. It is under the pressure of these difficulties that refuge is taken in the imagination of a future state—where it is assumed that all the disorders of the present scene are to be repaired, and full compensation made for the sufferings of our earthly existence. It is affirmed, that although the body dies the soul is unperishable, and, after it hath burst its unfettered way from the prison-house of its earthly tabernacle, that it will expatiate for ever in the full buoyancy and delight of its then emancipated energies—that, even as from the lacerated shell of the inert chrysalis the winged insect rises in all the pride of its now-expanded beauty among the fields of light and ether which are above it, so the human spirit finds its way through the opening made by death upon its corporeal framework among the glories of the upper Elysium. It is this immortality which is supposed to unriddle all the difficulties that attach to our present condition; which converts the evil that is in the world, into the instrument of a greatly over-passing good; and affords a scene for the imagination to rest upon, where all the anomalies which now exercise us shall be rectified, and where, from the larger prospects we shall then have of the whole march and destiny of man, the ways of God to His creatures shall appear in all the lustre of their full and noble vindication.

5. But as the superiority of the happiness over the misery of the world, affords insufficient premises on which to conclude the bene-

volence of God, *so long as God is conceived of under the partial view of possessing but this as his alone moral attribute*—but when that benevolence is employed as the argument for some ulterior doctrine in Natural Theology, it must impart to this latter the same inconclusiveness by which itself is characterised. The proof and the thing proved must be alike strong or alike weak. If the excess of enjoyment over suffering in the life that now is, be a matter of far too doubtful calculation, on which to rest a confident inference in favour of the divine benevolence; then, let this benevolence have no other prop to lean upon, and in its turn, it is far too doubtful a premise, on which to infer a coming immortality. Accordingly, to help out the argument, many of our slender and sentimental theists, who will admit of no other moral attribute for the divinity, than the paternal attribute of kind affection for the creatures who have sprung from Him do, in fact, assume the thing to be proved, and reason in a circle. The mere balance of the pleasures and pains of the present life, is greatly too uncertain, for what may be called an initial footing to this argument. But let a future life be assumed, in which all the defects and disorders of the present are to be repaired; and this may reconcile the doctrine of the benevolence of God, with the otherwise stumbling fact of the great actual wretchedness that is now in the world. Out of the observed phenomena of life and an assumed immortality together, a tolerable argument may be raised for this most pleasing and amiable of all the moral characteristics; but it is obvious that the doctrine of immortality enters into the premises of this first argument. But how is the immortality itself proved? not by the phenomena of life alone, but by these phenomena taken in conjunction with the divine benevolence—which benevolence, therefore, enters into the premise of the second argument. In the one argument, the doctrine of immortality is required to prove the benevolence of God. In the other this benevolence is required to prove the immortality. Each is used as an assumption for the establishment of the other; and this nullifies the reasoning for both. Either of these terms—that is, the divine benevolence, or a future state of compensation for the evils and inequalities of the present one—either of them, if admitted, may be held a very sufficient, or, at least, likely consideration on which to rest the other. But it makes very bad reasoning to vibrate between both—first to go forth with the assumption that God is benevolent, and therefore it is impossible that a scene so dark and disordered as that immediately before us can offer to our contemplation the full and final developement of all his designs for the human family; and then, feeling that this scene does not afford a sufficient basis on which to rest the demonstration of this attribute, to strengthen the basis and make it broader by the assertion, that it is not from a part of His ways, but from their complete and comprehensive whole, as made up both of time and eternity, that we draw the inference of a bene-

volent Deity, There is no march of argument. We swing as it were between two assumptions. It is like one of those cases in geometry, which remains indeterminate for the want of data. And the only effectual method of being extricated from such an ambiguity, would be the satisfactory assurance either of a benevolence independent of all considerations of immortality, or of an immortality independent of all the considerations of the benevolence.

6. But then it should be recollected that it is the partiality of our contemplation, and it alone which incapacitates this whole argument. There is a sickly religion of taste which clings exclusively to the parental benevolence of God; and will not, cannot brave the contemplation of His righteousness. It is this which makes the reasoning as feeble, as the sentiment is flimsy. It, in fact, leaves the system of natural theology without a ground-work—first to argue for immortality on the doubtful assumption of a supreme benevolence, and then to argue this immortality in proof of the benevolence. The whole fabric, bereft of argument and strength, is ready to sink under the weight of unresolved difficulties. The mere benevolence of the Deity is not so obviously or decisively the lesson of surrounding phenomena, as, of itself to be the foundation of a solid inference regarding either the character of God or the prospects of man. If we would receive the full lesson—if we would learn all which these phenomena, when rightly and attentively regarded, are capable of teaching—if along with the present indications of a benevolence, we take the present indications of a righteousness in God—out of these blended characteristics, we should have materials for an argument of firmer texture. It is to the leaving out of certain data, even though placed within the reach of observation, that the infirmity of the argument is owing—whereas, did we employ aright all the data in our possession, we might incorporate them together into the solid ground-work of a solid reasoning. It is by our sensitive avoidance of certain parts in this contemplation, that we enfeeble the cause. We should find a stable basis in existing appearances, did we give them a fair and full interpretation—as indicating not only the benevolence of God, but, both by the course of nature and the laws of man's moral economy, indicating his love of righteousness and hatred of iniquity. It might not resolve, but it would alleviate the mystery of things, could we within the sphere of actual observation, collect notices, not merely of a God who rejoiced in the physical happiness of His creatures, but of a God who had respect unto their virtue. Now the great evidence for this latter characteristic of the Divinity, lies near at hand—even among the intimacies of our own felt and familiar nature. It is not fetched by imagination from a distance, for every man has it within himself. The supremacy of conscience is a fact or phenomenon of man's moral constitution; and from this law of the heart, we pass, by the direct and legitimate inference, to

the character of Him who established it there. In a law, we read the character of the lawgiver; and this, whether it be a felt or a written law. We learn from the phenomena of conscience, that, however God may will the happiness of his creatures, His paramount and peremptory demand is for their virtue. He is the moral governor of a kingdom, as well as the father of a family; and it is a partial view that we take of Him, unless, along with the kindness which belongs to Him as a parent, we have respect unto that authority which belongs to Him as a sovereign and a judge. We have direct intimation of this in our own bosoms, in the constant assertion which is made there on the side of virtue, in the discomfort and remorse which attend its violation.

7. But though conscience be our original and chief instructor in the righteousness of God, the same lesson may be learned in another way. It may be gathered from the phenomena of human life—even those very phenomena, which so perplex the mind, so long as in quest of but one attribute and refusing to admit the evidence or even entertain the notion of any other,—it cherishes a partial and prejudiced view of the Diety. Those theists, who, in the spirit, have attempted to strike a balance between the pleasures and the pains of sentient nature, and to ground thereupon the very doubtful inference of the divine benevolence—seldom or never think of connecting these pleasures and pains with the moral causes, which, whether proximately or remotely, go before them. Without adverting to these, they rest their conclusion on the affirmed superiority, however ill or uncertainly made out, of the physical enjoyments over the physical sufferings of life. Now we hold it of capital importance in this argument, that, in our own species at least, both these enjoyments and these sufferings are mainly resolvable into moral causes—insomuch that, in the vast majority of cases, the deviation from happiness, can be traced to an anterior deviation from virtue; and that, apart from death and accident and unavoidable disease, the wretchedness of humanity is due to a vicious and ill regulated *morale*. When we thus look to the ills of life in their immediate origin, though it may not altogether dissipate, it goes far to reduce, and even to explain the mystery of their existence. Those evils which vex and agitate man, emanate, in the great amount of them, from the fountain of his own heart; and come forth, not of a distempered material, but of a distempered moral economy. Were each separate infelicity referred to its distinct source, we should, generally speaking, arrive at some moral perversity, whether of the affections or of the temper—so that but for the one, the other would not have been realized. It is true, that, perhaps in every instance, some external cause may be assigned, for any felt annoyance to which our nature is liable; but then, it is a cause without, operating on a sensibility within. So that in all computations, whether of suffering or of enjoyment, the state of the subjective or recipient

mind must be taken into account, as well as the influences which play upon it from the surrounding world; and what we affirm is, that, to a rightly conditioned mind, the misery would be reduced and the happiness augmented tenfold. When disappointment agonizes the heart; or a very slight, perhaps unintentional neglect, lights up in many a soul the fierceness of resentment; or coldness, and disdain, and the mutual glances of contempt and hatred, circulate a prodigious mass of infelicity through the world—these are to be ascribed, not to the untowardness of outward circumstances, but to the untowardness of man's own constitution, and are the fruits of a disordered spiritual system. And the same may be said of the poverty which springs from indolence or dissipation; of the disgrace which comes to the back of misconduct; of the pain or uneasiness which festers in every heart that is the prey, whether of licentious or malignant passions; in short, of the general restlessness and un-hingement of every spirit, which, thrown adrift from the restraints of principle, has no well-spring of satisfaction in itself, but precariously vacillates, in regard to happiness, with the hazard and the casual fluctuation of outward things. There are, it is true, sufferings purely physical, which belong to the sentient and not to the moral nature—as the maladies of infant disease, and the accidental inflictions wherewith the material frame is sometimes agonized. Still it will be found, that the vast amount of human wretchedness, can be directly referred to the waywardness and morbid state of the human will—to the character of man, and not to the condition which he occupies.

8. Now what is the legitimate argument for the character of God, not from the mere existence of misery, but from the existence of misery thus originated? Wretchedness, of itself, were fitted to cast an uncertainty, even a suspicion, on the benevolence of God. But wretchedness as the result of wickedness, may not indicate the negation of this one attribute. It may only indicate the reality or the presence of another. Suffering without a cause and without an object, may be the infliction of a malignant being. But suffering in alliance with sin, should lead to a very different conclusion. When thus related it may cast no impeachment on the benevolence, and only bespeak the righteousness of God. It tells us that however much he may love the happiness of His creatures, He loves their virtue more. So that, instead of extinguishing the evidence of one perfection, it may leave this evidence entire, and bring out into open manifestation another perfection of the Godhead.

9. In attempting to form our estimate of the divine character from the existing phenomena, the fair proceeding would be, not to found it on the actual miseries which abound in the world, peopled with a depraved species—but on the fitnesses which abound in the world, to make a virtuous species happy. We should try to figure its result on human life, were perfect virtue to revisit earth, and take up

its abode in every family. The question is, are we so constructed and so accommodated, that, in the vast majority of cases we, if morally right, should be physically happy. What, we should ask, is the real tendency of nature's laws—whether to minister enjoyment to the good or the evil? It were a very strong, almost an unequivocal testimony to the righteousness of Him, who framed the system of things and all its adaptations—if, while it secured a general harmony between the virtue of mankind and their happiness or peace, it as constantly impeded either the prosperity or the heart's ease of the profligate and the lawless. Now of this we might be informed by an actual survey of human life. We can justly imagine the consequences upon human society—were perfect uprightness and sympathy and good-will to obtain universally; were every man to look to his fellow with a brother's eye; were a universal courteousness to reign in our streets and our houses and our market-places, and this to be the spontaneous emanation of a universal cordiality; were each man's interest and reputation as safe in the custody of another, as he now strives to make them by a jealous guardianship of his own; were, on the one hand, a prompt and eager benevolence on the part of the rich, ever on the watch to meet, nay, to overpass all the wants of humanity, and, on the other hand, an honest moderation and independence on the part of the poor, to be a full defence for their superiors against the encroachments of deceit and rapacity; were liberality to walk diffusively abroad among men, and love to settle pure and unruffled in the bosom of families; were that moral sunshine to arise in every heart, which purity and innocence and kind affection are ever sure to kindle there; and even when some visitation from without was in painful dissonance with the harmony within, were a thousand sweets ready to be poured into the cup of tribulation from the feeling and the friendship of all the good who were around us—on this single transition from vice to virtue among men, does there not hinge the alternative between a pandæmonium and a paradise? If the moral elements were in place and operation among us, should we still continue to fester and be unhappy from the want of the physical? Or, is it not rather true, that all nature smiles in beauty, or wantons in bounteousness for our enjoyment—were but the disease of our spirits medicated, were there but moral soundness in the heart of man!

10. And what must be the character of the Being who formed such a world, where the moral and the physical economies are so adjusted to each other, that virtue, if universal, would bring ten thousand blessings and beatitudes in its train, and turn our earth into an elysium—whereas nothing so distempers the human spirit, and so multiplies distress in society, as the vice and the violence and the varieties of moral turpitude wherewith it is invested. Would a God who loved iniquity and who hated righteousness have created such a world? Would he have so attuned the organism of the hu-

man spirit, that the consciousness of worth should be felt through all its recesses, like the oil of gladness? Or would He have so constructed the mechanism of human society, that it should never work prosperously for the general good of the species, but by means of truth and philanthropy and uprightness? Would the friend and patron of falsehood have let such a world out of his hands? Or would an unholy being have so fashioned the heart of man—that, wayward and irresolute as he is, he never feels so ennobled, as by the high resolve that would spurn every base allurements of sensuality away from him; and never breathes so ethereally, as when he maintains that chastity of spirit which would recoil even from one unhallowed imagination; and never rises to such a sense of grandeur and godlike elevation, as when principle hath taken the direction, and is vested with full ascendancy over the restrained and regulated passions? What other inference can be drawn from such sequences as these, but that our moral architect loves the virtue He thus follows up with the delights of a high and generous complacency; and execrates the vice He thus follows up with disgust and degradation? If we look but to misery unconnected and alone, we may well doubt the benevolence of the Deity. But should it not modify the conclusion, to have ascertained—that, in proportion as virtue made entrance upon the world, misery would retire from it? There is nothing to spoil Him of this perfection, in a misery so originated; but, leaving this perfection untouched, it attaches to Him another, and we infer, that He is not merely benevolent, but benevolent and holy. After that the moral cause has been discovered for the unhappiness of man, we feel Him to be a God of benevolence still; that He wills the happiness of his creatures, but with this reservation, that the only sound and sincere happiness He awards to them, is happiness through the medium of virtue; that still He is willing to be the dispenser of joy substantial and unfading, but of no such joy apart from moral excellence; that He loves the gratification of His children, but He loves their righteousness more; that dear to Him is the happiness of all His offspring, but dearer still their worth, and that therefore He, the moral governor, will so conduct the affairs of His empire, as that virtue and happiness, or that vice and misery shall be associated.

11. We have already said, that, by inspecting a mechanism, we can infer both the original design of Him who framed it, and the derangement it has subsequently undergone—even as by the inspection of a watch, we can infer from the place of command which its regulator occupies, that it was made for the purpose of moving regularly; and that, notwithstanding the state of disrepair and aberration into which it may have fallen. And so, from the obvious place of rightful supremacy which is occupied by the conscience of man in his moral system, we can infer that virtue was the proper and primary design of his creation; and that, notwithstanding the actual preva-

lence of obviously inferior principles, over the habits and history of his life. Connect this with the grand and general adaptation of External Nature for which we have now been contending—even the capacity of that world in which we are placed for making a virtuous species happy; and it were surely far juster, in arguing for the divine character, that we founded our interpretation on the happiness which man's original constitution is fitted to secure for him, than on the misery which he suffers by that constitution having been in some way perverted. It is from the native and proper tendency of aught which is made, that we conclude as to the mind and disposition of the maker; and not from the actual effect, when that tendency has been rendered abortive, by the extrinsic operation of some disturbing force on an else goodly and well-going mechanism. The original design of the Creator may be read in the natural, the universal tendency of things; and surely, it speaks strongly both for His benevolence and His righteousness that nothing is so fitted to ensure the general happiness of society as the general virtue of them who compose it. And if, instead of this, we behold a world, ill at ease, with its many heart-burnings and many disquietudes—the fair conclusion is, that the beneficial tendencies which have been established therein, and which are therefore due to the benevolence of God, have all been thwarted by the moral perversity of man. The compound lesson to be gathered from such a contemplation is, that God is the friend of human happiness but the enemy of human vice—seeing, He hath set up an economy in which the former would have grown up and prospered universally, had not the latter stepped in and overborne it.

12. We are now on a ground work of a more firm texture, for an argument in behalf of man's immortality. But it is only by a more comprehensive view both of the character of God, and the actual state of the world—that we obtain as much evidence both for His benevolence and His righteousness, as might furnish logical premises for the logical inference of a future state.

13. We have already stated that the miseries of life, in their great and general amount, are resolvable into moral causes; and did each man suffer here, accurately in proportion to his own sins, there might be less reason for the anticipation of another state hereafter. But this proportion is, in no individual instance perhaps, ever realized on this side of death. The miseries of the good are still due to a moral perversity—though but to the moral perversity of others, not of his own. He suffers from the injustice and calumny and violence and evil tempers of those who are around him. On the large and open theatre of the world, the cause of oppression is often the triumphant one; and, in the bosom of families, the most meek and innocent of the household, are frequently the victims for life, of a harsh and injurious though unseen tyranny. It is this inequality of fortune, or rather of enjoyment, between the good and the evil, which forms

the most popular, and enters as a constituent part at least, into the most powerful argument, which nature furnishes, for the immortality of the soul. We cannot imagine of a God of righteousness, that He will leave any question of justice unsettled; and there is nothing which more powerfully suggests to the human conscience the apprehension of a life to come, than that in this life, there should be so many unsettled questions of justice—first between man and man, secondly between man and his Maker.

14. The strength of the former consideration lies in the multiplicity, and often the fearful aggravation, of the unredressed wrongs, inflicted every day by man upon his fellows. The history of human society teems with these; and the unappeased cry, whether for vengeance or reparation, rises to heaven because of them. We might here expatiate on the monstrous, the wholesale atrocities, perpetrated on the defenceless by the strong; and which custom has almost legalized—having stood their ground against the indignation of the upright and the good for many ages. Perhaps for the most gigantic example of this, in the dark annals of our guilty world, we should turn our eyes upon injured Africa—that devoted region, where the lust of gain has made the fiercest and fellest exhibition of its hardihood; and whose weeping families are broken up in thousands every year, that the families of Europe might the more delicately and luxuriously regale themselves. It is a picturesque, and seems a powerful argument for some future day of retribution, when we look, on the one hand, to the prosperity of the lordly oppressor, wrung from the sufferings of a captive and subjugated people; and look, on the other, to the tears and the untold agony of the hundreds beneath him, whose lives of dreariness and hard labour are tenfold embittered, by the imagery of that dear and distant land, from which they have been irrecoverably torn. But, even within the confines of civilized society, there do exist materials for our argument. There are cruelties and wrongs innumerable, in the conduct of business; there are even cruelties and wrongs, in the bosom of families. There are the triumphs of injustice; the success of deep-laid and malignant policy on the one side, on the other the ruin and the overthrow of unprotected weakness. Apart from the violence of the midnight assault, or the violence of the highway—there is, even under the forms of law, and amid the blandness of social courtesies, a moral violence that carries as grievous and substantial iniquity in its train; by which friendless and confiding simplicity may at once be bereft of its rights, and the artful oppressor be enriched by the spoliation. Have we never seen the bankrupt rise again with undiminished splendour, from amid the desolation and despair of the families that have been ruined by him? Or, more secret though not less severe, have we not seen the inmates of a wretched home doomed to a hopeless and unhappy existence, under the sullen brow of the tyrant who lorded over them? There are sufferings from

which there is no redress or rectification upon earth; inequalities between man and man, of which there is no adjustment here—but because of that very reason, there is the utmost desire, and we might add expectancy of our nature, that there shall be an adjustment hereafter. In the unsated appetency of our hearts for justice, there is all the force of an appeal to the Being who planted the appetite within us; and we feel that if Death is to make sudden disruption, in the midst of all these unfinished questions, and so to leave them eternally—we feel a violence done both to our own moral constitution, and to the high jurisprudence of Him who framed us.

15. But there are furthermore, in this life, unfinished questions between man and his Maker. The same conscience which asserts its own supremacy within the breast, suggests the God and the Moral Governor who placed it there. It is thus that man not only takes cognisance of his own delinquencies; but he connects them with the thought of a lawgiver to whom he is accountable. He passes by one step, and with rapid inference, from the feeling of a judge who is within, to the fear of a Judge who sits in high authority over him. With the sense of a reigning principle in his own constitution, there stands associated the sense of a reigning power in the universe—the one challenging the prerogatives of a moral law, the other avenging the violation of them. Even the hardest in guilt are not insensible to the force of this sentiment. They feel it, as did Catiline and the worst of Roman emperors, in the horrors of remorse. There is, in spite of themselves, the impression of an avenging God—not the less founded upon reasoning, that it is the reasoning of but one truth or rather of but one transition, from a thing intimately known to a thing immediately concluded, from the reckoning of a felt and a present conscience within, to the more awful reckoning of a God who is the author of conscience and who knoweth all things. Now, it is thus that men are led irresistibly to the anticipation of a future state—not by their hopes, we think, but by their fears; not by a sense of unfulfilled promises, but by the sense and the terror of unfulfilled penalties; by their sense of a judgment not yet executed, of a wrath not yet discharged upon them. Hence the impression of a futurity upon all spirits, whither are carried forward the issues of a jurisprudence, which bears no marks but the contrary of a full and final consummation on this side of death. The prosperity of many wicked who spend their days in resolute and contemptuous irreligion; the practical defiance of their lives to the bidding of conscience, and yet a voice of remonstrance and of warning from this said conscience which they are unable wholly to quell; the many emphatic denunciations, not uttered in audible thunder from above, but uttered in secret and impressive whispers from within—these all point to accounts between God and His creatures that are yet unfinished. If there be no future state,

the great moral question between heaven and earth, broken off at the middle, is frittered into a degrading mockery. There is violence done to the continuity of things. The moral constitution of man is stript of its significancy and the Author of that constitution is stript of His wisdom and authority and honour. That consistent march which we behold in all the cycles, and progressive movements of the natural economy, is, in the moral economy, brought to sudden arrest and disruption—if death annihilate the man, instead of only transforming him. And it is only the doctrine of his immortality by which all can be adjusted and harmonized.*

16. And there is one especial proof for the immortality of the soul, founded on adaptation; and therefore so identical in principle with the subject and main argument of our essay—that we feel its statement to be our best and most appropriate termination of this especial inquiry. The argument is this. For every desire or every faculty, whether in man or in the inferior animals, there seems a counterpart object in external nature. Let it be either an appetite or a power; and let it reside either in the sentient or in the intellectual or in the moral economy—still there exists a something without that is altogether suited to it, and which seems to be expressly provided for its gratification. There is light for the eye; there is air for the lungs; there is food for the ever recurring appetite of hunger; there is water for the appetite of thirst; there is society for the love, whether of fame or of fellowship; there is a boundless field in all the objects of all the sciences for the exercise of curiosity—in a word, there seems not one affection in the living creature, which is not met by a counterpart and a congenial object in the surrounding creation. It is this, in fact, which forms an important class of those adaptations, on which the argument for a Deity is founded. The adaptation of the parts to each other within the organic structure, is distinct from the adaptation of the whole to the things of circumambient nature; and is well unfolded in a separate chapter by Paley, on the relation of inanimate bodies to animated nature. But there is another chapter on prospective contrivances, in which he unfolds to us other adaptations, that approximate still more nearly to our argument. They consist of embryo arrangements or parts, not of immediate use, but to be of use eventually—preparations going on in the animal economy, whereof the full benefit is not to be realized, till some future and often considerably distant developement shall have taken place; such as the teeth buried in their sockets, that would be inconvenient during the first months of infancy, but come forth when it is sufficiently advanced for another and a new sort of nourishment; such as the manifold preparations, anterior to the birth, that

* It is well said by Mr. Davison, in his profound and original work on Prophecy—that “Conscience and the *present* constitution of things are not corresponding terms. The one is not the object of perception to the other. It is conscience and the issue of things which go together.”

are of no use to the fœtus, but are afterwards to be of indispensable use in a larger and freer state of existence; such as the instructive tendencies to action that appear before even the instruments of action are provided, as in a calf of a day old to butt with its head before it has been furnished with horns. Nature abounds, not merely in present expedients for an immediate use, but in providential expedients for a future one; and, as far as we can observe, we have no reason to believe, that, either in the first or second sort of expedients, there has ever aught been noticed, which either bears on no object now, or lands in no result afterwards. We may perceive in this, the glimpse of an argument for the soul's immortality. We may enter into the analogy, as stated by Dr. Ferguson, when he says—"whoever considers the anatomy of the fœtus, will find, in the strength of bones and muscles, in the organs of respiration and digestion, sufficient indications of a design to remove his being into a different state. The observant and the intelligent may perhaps find in the mind of man parallel signs of his future destination.*"

17. Now what inference shall we draw from this remarkable law in nature, that there is nothing waste and nothing meaningless in the feelings and faculties wherewith living creatures are endowed? For each desire there is a counterpart object, for each faculty there is room and opportunity of exercise—either in the present, or in the coming futurity. Now, but for the doctrine of immortality, man would be an exception to this law. He would stand forth as an anomaly in nature—with aspirations in his heart for which the universe had no antitype to offer, with capacities of understanding

* Dr. Ferguson's reasoning upon this subject is worthy of being extracted more largely than we have room for in the text—"If the human fœtus," he observes, "were qualified to reason of his prospects in the womb of his parent, as he may afterwards do in his range on this terrestrial globe, he might no doubt apprehend in the breach of his umbilical chord, and in his separation from the womb a total extinction of life, for how could he conceive it to continue after his only supply of nourishment from the vital stock of his parent had ceased? He might indeed observe many parts of his organization and frame which should seem to have no relation to his state in the womb. For what purpose, he might say, this duct which leads from the mouth to the intestines? Why these bones that each apart become hard and stiff, while they are separated from one another by so many flexures or joints? Why these joints in particular made to move upon hinges, and these germs of teeth, which are pushing to be felt above the surface of the gums? Why the stomach through which nothing is made to pass? And these spongy lungs, so well fitted to drink up the fluids, but into which the blood that passes every where else is scarcely permitted to enter?"

"To these queries, which the fœtus was neither qualified to make nor to answer, we are now well apprized the proper answer would be—the life which you now enjoy is but temporary; and those particulars which now seem to you so preposterous, are a provision which nature has made for a future course of life which you have to run, and in which their use and propriety will appear sufficiently evident.

"Such are the prognostics of a future destination that might be collected from the state of the fœtus; and similiar prognostics of a destination still future might be collected from present appearances in the life and condition of man."

and thought, that never were to be followed, by objects of corresponding greatness, through the whole history of his being. It were a violence to the harmony of things, whereof no other example can be given; and, in as far as an argument can be founded on this harmony for the wisdom of Him who made all things—it were a reflection on one of the conceived, if not one of the ascertained attributes of the Godhead. To feel the force of this argument, we have only to look to the obvious adaptation of his powers to a larger and more enduring theatre—to the dormant faculties which are in him for the mastery and acquisition of all the sciences, and yet the partial ignorance of all, and the profound or total ignorance of many, in which he spends the short-lived years of his present existence—to the boundless, but here, the unopened capabilities which lie up in him, for the comprehension of truths that never once draw his attention on this side of death, for the contemplative enjoyment both of moral and intellectual beauties which have never here revealed themselves to his gaze. The whole labour of this mortal life would not suffice, for traversing in full extent any one of the sciences; and yet, there may lie undeveloped in his bosom, a taste and talent for them all—none of which he can even singly overtake; for each science, though definite in its commencement, has its out-goings in the infinite and the eternal. There is in man, a restlessness of ambition; an interminable longing after nobler and higher things, which nought but immortality and the greatness of immortality can satiate; a dissatisfaction with the present, which never is appeased by all that the world has to offer; an impatience and distaste with the felt littleness of all that he finds, and an unsated appetency for something larger and better, which he fancies in the perspective before him—to all which there is nothing like among any of the inferior animals, with whom, there is a certain squareness of adjustment, if we may so term it, between each desire and its correspondent gratification. The one is evenly met by the other; and there is a fulness and definiteness of enjoyment, up to the capacity of enjoyment. Not so with man, who both from the vastness of his propensities and the vastness of his powers, feels himself straitened and beset in a field too narrow for him. He alone labours under the discomfort of an incongruity between his circumstances and his powers; and, unless there be new circumstances awaiting him in a more advanced state of being, he, the noblest of Nature's products here below, would turn out to be the greatest of her failures.

PART II.

ON THE ADAPTATION OF EXTERNAL NATURE TO THE INTELLECTUAL CONSTITUTION OF MAN.

CHAPTER I.

Chief Instances of this Adaptation.

1. (1.) THE law of most extensive influence over the phenomena and processes of the mind, is the law of association, or, as denominated by Dr. Thomas Brown, the law of suggestion. If two objects have been seen in conjunction, or in immediate succession, at any one time—then the sight or thought of one of them afterwards, is apt to suggest the thought of the other also; and the same is true of the objects of all the senses. The same smells or sounds or tastes which have occurred formerly, when they occur again, will often recall the objects from which they then proceeded, the occasions or other objects with which they were then associated. When one meets with a fragrance of a particular sort, it may often instantly suggest a fragrance of the same kind experienced months or years ago; the rose-bush from which it came; the garden where it grew; the friend with whom we then walked; his features, his conversation, his relatives, his history. When two ideas have been once in juxta-position, they are apt to present themselves in juxta-position over again—an aptitude which ever increases the oftener that the conjunction has taken place, till, as if by an invincible necessity, the antecedent thought is sure to bring its usual consequent along with it; and, not only single sequences, but lengthened trains or progressions of thought, may in this manner be explained.

2. And such are the great speed and facility of these successions, that many of the intermediate terms, though all of them undoubtedly present to the mind, flit so quickly and evanescently, as to pass unnoticed. This will the more certainly happen, if the antecedents are of no further use than to introduce the consequents; in which case, the consequents remain as the sole objects of attention, and the an-

tecedents are forgotten. In the art of reading, the ultimate object is to obtain possession of the author's sentiments or meaning; and all memory of the words, still more of the component letters, though each of them must have been present to the mind, pass irrecoverably away from it. In like manner, the anterior steps of many a mental process may actually be described, yet without consciousness—the attention resting, not on the fugitive means, but on the important end in which they terminate. It is thus that we seem to judge, on the instant, of distances, as if under a guidance that was immediate and instinctive, and not by the result of a derivative process—because insensible to the rapid train of inference which led to it. The mind is too much occupied with the information itself, for looking back on the light and shadowy footsteps of the messenger who brought it, which it would find difficult if not impossible to trace—and besides, having no practical call upon it for making such a retrospect. It is thus that, when looking intensely on some beautiful object in Nature, we are so much occupied with the resulting enjoyment as to overlook the intermediate train of unbidden associations, which connects the sight of that which is before us, with the resulting and exquisite pleasure, that we feel in the act of beholding it. The principle has been much resorted to, in expounding that process by which the education of the senses is carried forward; and, more especially, the way in which the intimations of sight and touch are made to correct and to modify each other. It has also been employed with good effect, in the attempt to establish a philosophy of taste. But these rapid and fugitive associations, while they form a real, form also an unseen process; and we are not therefore to wonder, if along with many solid explanations, they should have been so applied in the investigation of mental phenomena, as occasionally to have given rise to subtle and fantastic theories.

3. But our proper business at present is with results, rather than with processes; and instead of entering on the more recondite inquiries of the science, however interesting and however beautiful or even satisfactory the conclusions may be to which they lead—it is our task to point out those palpable benefits and subserviencies of our intellectual constitution, which demonstrate, without obscurity, the benevolent designs of Him who framed us. There are some of our mental philosophers, indeed, who have theorised and simplified beyond the evidence of those facts which lie before us; and our argument should be kept clear, for in reality it does not partake, in the uncertainty or error of their speculations. The law of association, for example, has been of late reasoned upon, as if it were the sole parent and predecessor of all the mental phenomena. Yet it does not explain, however largely it may influence, the phenomena of memory. When by means of one idea, anyhow awakened in the mind, the whole of some past transaction or scene is brought to re-

collection, it is association which recalls to our thoughts this portion of our former history. But association cannot explain our recognition of its actual and historical truth—or what it is, which, beside an act of conception, makes it also an act of remembrance. By means of this law we may understand how it is, that certain ideas, suggested by certain others which came before it, are now present to the mind. But superadded to the mere presence of these ideas, there is such a perception of the reality of their archetypes, as distinguishes a case of remembrance from a case of imagination—inasmuch that over and above the conception of certain objects, there is also a conviction of their substantive being at the time which we connect with the thought of them; and this is what the law of association cannot by itself account for. It cannot account for our reliance upon memory—not as a conjuror of visions into the chamber of imagery, but as an informer of stable and objective truths which had place and fulfilment in the actual world of experience.

4. And the same is true of our believing anticipations of the future, which we have now affirmed to be true of our believing retrospects of the past. The confidence wherewith we count on the same sequences in future, that we have observed in the course of our past experience, has been resolved by some philosophers, into the principle of association alone. Now when we have seen a certain antecedent followed up by a certain consequent, the law of association does of itself afford a sufficient reason, why the idea of that antecedent should be followed up by the idea of its consequent; but it contains within it no reason, why, on the actual occurrence again of the antecedent, we should believe that the consequent will occur also. That the thought of the antecedent should suggest the thought of the consequent, is one mental phenomenon. That the knowledge of the antecedent having anew taken place, should induce the certainty, that the consequent must have taken place also, is another mental phenomenon. We cannot confound these two, without being involved in the idealism of Hume or Berkeley. Were the mere thought of the consequent all that was to be accounted for, we need not go farther than to the law of association. But when to the existence of this thought, there is superadded a belief in the reality of its archetype, a distinct mental phenomenon comes into view, which the law of association does not explain; and which, for aught that the analysts of the mind have yet been able to trace or to discover, is an ultimate principle of the human understanding. This belief, then, is one thing. But ere we can make out an adaptation, we must be able to allege at least two things. And they are ready to our hands—for, in addition to the belief in the subjective mind, there is a correspondent and counterpart reality in objective nature. If we have formerly observed that a given antecedent is followed by a certain consequent, then, not only does the idea of the antecedent suggest the idea of the consequent; but

there is a belief, that, on the actual occurrence of the same antecedent, the same consequent will follow over again. And the consequent does follow; or, in other words, this our instinctive faith meets with its unexcepted fulfilment, in the actual course and constancy of nature. The law of association does of itself, and without going further, secure this general convenience—that the courses of the mind are thereby conformed, or are made to quadrate and harmonise with the courses of the outer world. It is the best possible construction for the best and most useful guidance of the mind, as in the exercise of memory for example, that thought should be made to follow thought, according to the order in which the objects and events of nature are related to each other. But a belief in the certainty and uniformity of this order, with the counterpart verification of this belief in the actual history of things, is that which we now are especially regarding. It forms our first instance, perhaps the most striking and marvellous of all, of the adaptation of external nature to the intellectual constitution of man.

5. This disposition to count on the uniformity of Nature, or even to anticipate the same consequents from the same antecedents—is not the fruit of experience, but anterior to it; or at least anterior to the very earliest of those of her lessons, which can be traced backward in the history of an infant mind. Indeed it has been well observed by Dr. Thomas Brown, that the future constancy of Nature, is a lesson, which no observation of its past constancy, or no experience could have taught us. Because we have observed A a thousand times to be followed in immediate succession by B, there is no greater logical connexion between this proposition and the proposition that A will always be followed by B; than there is between the propositions that we have seen A followed once by B, and therefore A will always be followed by B. At whatever stage of the experience, the inference may be made, whether longer or shorter, whether oftener or seldomer repeated—the conversion of the past into the future seems to require a distinct and independent principle of belief; and it is a principle which, to all appearance, is as vigorous in childhood, as in the full maturity of the human understanding. The child who strikes the table with a spoon for the first time, and is regaled by the noise, will strike again, with as confident an expectation of the same result, as if the succession had been familiar to it for years. There is the expectation before the experience of Nature's constancy; and still the topic of our wonder and gratitude is, that this instinctive and universal faith in the heart, should be responded to by objective nature, in one wide and universal fulfilment.

6. The proper office of experience, in this matter, is very generally misapprehended; and this has mystified the real principle and philosophy of the subject. Her office is not to tell, or to re-assure us of the constancy of Nature; but to tell, what the terms of her

unalterable progressions actually are. The human mind from its first outset, and in virtue of a constitutional bias coeval with the earliest dawn of the understanding, is prepared, and that before experience has begun her lessons, to count on the constancy of nature's sequences. But at that time, it is profoundly ignorant of the sequences in themselves. It is the proper business of experience to give this information; but it may require many lessons before that her disciples be made to understand, what be the distinct terms even but of one sequence. Nature presents us with her phenomena in complex assemblages; and it is often difficult, in the work of disentangling her trains from each other, to single out the proper and causal antecedent with its resulting consequent, from among the crowd of accessory or accidental circumstances by which they are surrounded. There is never any uncertainty, as to the invariableness of nature's successions. The only uncertainty is as to the steps of each succession; and the distinct achievement of experience, is to ascertain these steps. And many mistakes are committed in this course of education, from our disposition to confound the similarities with the samenesses of Nature. We never misgive in our general confidence, that the same antecedent will be followed by the same consequent; but we often mistake the semblance for the reality, and are as often disappointed in the expectations that we form. This is the real account of that growing confidence, where-with we anticipate the same results in the same apparent circumstances, the oftener that that result has in these circumstances been observed by us—as of a high-water about twice every day, or of a sun-rise every morning. It is not that we need to be more assured than we are already of the constancy of Nature, in the sense that every result must always be the sure effect of its strict and causal antecedent. But we need to be assured of the real presence of this antecedent, in that mass of contemporaneous things under which the result has taken place hitherto; and of this we are more and more satisfied, with every new occurrence of the same event in the same apparent circumstances. This too is our real object in the repetition of experiments. Not that we suspect that Nature will ever vacillate from her constancy—for if by one decisive experiment we should fix the real terms of any succession, this experiment were to us as good as a thousand. But each succession in nature is so liable to be obscured and complicated by other influences, that we must be quite sure, ere we can proclaim our discovery of some new sequence, that we have properly disentangled her separate trains from each other. For this purpose, we have often to question Nature in many different ways; we have to combine and apply her elements variously; we have sometimes to detach one ingredient, or to add another, or to alter the proportions of a third—and all in order, not to ascertain the invariableness of Nature, for of this we have had instinctive certainty from the beginning; but, in order to ascertain what the actual footsteps of her progressions are, so as

to connect each effect in the history of Nature's changes with its strict and proper cause. Meanwhile, amid all the suspense and the frequent disappointments which attend this search into the processes of nature, our confidence in the rigid and inviolable uniformity of these processes remains unshaken—a confidence not learned from experience, but amply confirmed and accorded to by experience. For this instinctive expectation is never once refuted, in the whole course of our subsequent researches. Nature though stretched on a rack, or put to the torture by the inquisitions of science, never falters from her immutability; but persists, unseduced and unwearied, in the same response to the same question; or gives forth, by a spark, or an explosion, or an effervescence, or some other definite phenomenon, the same result to the same circumstances or combination of data. The anticipations of infancy meet with their glorious verification, in all the findings of manhood; and a truth which would seem to require Omniscience for its grasp, as coextensive with all Nature and all History, is deposited by the hand of God, in the little cell of a nursling's cogitations.

7. Yet the immutability of Nature has ministered to the atheism of some spirits, as impressing on the universe a character of blind necessity, instead of that spontaneity, which might mark the intervention of a willing and a living God. To refute this notion of an unintelligent fate, as being the alone presiding Divinity, the common appeal is to the infinity and exquisite skill of nature's adaptations. But to attack this infidelity in its fortress, and dislodge it thence, the more appropriate argument would be the very, the individual adaptation on which we have now insisted—the immutability of Nature, in conjunction with the universal sense and expectation, even from earliest childhood, that all men have of it; being itself one of the most marvellous and strikingly beneficial of these adaptations. When viewed aright, it leads to a wiser and sounder conclusion than that of the fatalists. In the instinctive, the universal faith of Nature's constancy, we behold a promise. In the actual constancy of Nature, we behold its fulfilment. When the two are viewed in connexion, then, to be told that Nature never recedes from her constancy, is to be told that the God of Nature never recedes from his faithfulness. If not by a whisper from His voice, at least by the impress of His hand, He hath deposited a silent expectation in every heart; and He makes all Nature and all History conspire to realize it. He hath not only enabled man to retain in his memory a faithful transcript of the past; but by means of this constitutional tendency, this instinct of the understanding as it has been termed, to look with prophetic eye upon the future. It is the link by which we connect experience with anticipation—a power or exercise of the mind coeval with the first dawnings of consciousness or observation, because obviously that to which we owe the confidence so early ac-

quired and so firmly established, in the information of our senses.* This disposition to presume on the constancy of nature, commences with the faculty of thought, and keeps by it through life, and enables the mind to convert its stores of memory into the treasures of science and wisdom; and so to elicit from the recollections of the past, both the doctrines of a general philosophy, and the lessons of daily and familiar conduct—and that, by means of prognostics, not one of which can fail, for, in respect of her steadfast uniformity, Nature never disappoints, or, which is equivalent to this, the Author of Nature never deceives us. The generality of Nature's laws is indispensable, both to the formation of any system of truth for the

* It is from our tactual sensations that we obtain our first original perceptions of distance and magnitude; and it is only because of the invariable connexion which subsists between the same tactual and the same visual sensations, that by means of the latter we obtain secondary or acquired perceptions of distance and magnitude. It is obvious that without a faith in the uniformity of nature, this rudimental education could not have taken effect; and from the confidence wherewith we proceed in very early childhood on the intimations of the eye, we may infer how strongly this principle must have been at work throughout the anterior stage of our still earlier infancy. The lucid and satisfactory demonstration upon this subject in that delightful little work, the *Theory of Vision*, by Bishop Berkeley, has not been superseded, because it has not been improved upon, by the lucubrations of any subsequent author. The theology which he would found on the beautiful process which he has unfolded so well, is somewhat tinged with the mysticism of that doctrine which represents our seeing all things in God. Certain it is, however, that the process could not have been advanced or consummated, without an aboriginal faith on the part of the infant mind in the uniformity of nature's sequences, a disposition to expect the same consequents from the same antecedents—an inference which is at length made, and that in very early childhood, with such rapidity as well as confidence, that it leads all men to confound their acquired with their original perceptions; and it requires a subtle analysis to disentangle the two from each other. Without partaking in the metaphysics of Berkeley, we fully concur in the strength and certainty of those theistical conclusions which are expressed by him in the following sentences—"Something there is of divine and admirable in this language addressed to our eyes, that may well awaken the mind, and deserve its utmost attention; it is learned with so little pains, it expresses the difference of things so clearly and aptly, it instructs with such facility and despatch, by one glance of the eye conveying a greater variety of advices, and a more distinct knowledge of things, than could be got by a discourse of several hours; and, while it informs, it amuses and entertains the mind with such singular pleasure and delight; it is of such excellent use in giving a stability and permanency to human discourse, in recording sounds and bestowing life on dead languages, enabling us to converse with men of remote ages and countries; and it answers so apposite to the uses and necessities of mankind, informing us more distinctly of those objects, whose nearness or magnitude qualify them to be of greatest detriment or benefit to our bodies, and less exactly in proportion as their littleness or distance make them of less concern to us. But these things are not strange, they are familiar, and that makes them to be overlooked. Things which rarely happen strike; whereas frequency lessens the admiration of things, though in themselves ever so admirable. Hence a common man who is not used to think and make reflections, would probably be more convinced of the being of a God by one single sentence heard once in his life from the sky, than by all the experience he has had of this visual language, contrived with such exquisite skill, so constantly addressed to his eyes, and so plainly declaring the nearness, wisdom, and providence of Him with whom we have to do." *Minute Philosopher. Dialogue IV. Art. XV.*

understanding, and to the guidance of our actions. But ere we can make such use of it, the sense and the confident expectation of this generality must be previously in our minds; and the concurrence, the contingent harmony of these two elements; the exquisite adaptation of the objective to the subjective, with the manifest utilities to which it is subservient; the palpable and perfect meetness which subsists, between this intellectual propensity in man, and all the processes of the outward universe—while they afford incontestable evidence to the existence and unity of that design, which must have adjusted the mental and the material formations to each other, speak most decisively in our estimation both for the truth and the wisdom of God.

8. We have long felt this close and unexpected, while at the same time, contingent harmony, between the actual constancy of Nature and man's faith in that constancy, to be an effectual preservative against that scepticism, which would represent the whole system of our thoughts and perceptions to be founded on an illusion. Certain it is, that beside an indefinite number of truths received by the understanding as the conclusions of a proof more or less lengthened, there are truths recognised without proof by an instant act of intuition—not the results of a reasoning process, but themselves the first principles of all reasoning. At every step in the train of argumentation, we affirm one thing to be true, because of its logical connexion with another thing known to be true; but as this process of derivation is not eternal, it is obvious, that, at the commencement of at least some of these trains, there must be truths, which, instead of borrowing their evidence from others, announce themselves immediately to the mind in an original and independent evidence of their own. Now they are these primary convictions of the understanding, these cases of a belief without reason, which minister to the philosophical infidelity of those, who, professing to have no dependence on an instinctive faith, do, in fact, alike discard all truth, whether demonstrated or undemonstrated—seeing that underived or unreasoned truth must necessarily form the basis, as well as the continuous cement of all reasoning. They challenge us to account for these native and original convictions of the mind; and affirm that they may be as much due to an arbitrary organization of the percipient faculty, as to the objective trueness of the things which are perceived. And we cannot dispute the possibility of this. We can neither establish by reasoning those truths, whose situation is, not any where in the stream, but at the fountain of ratiocination; nor can we deny that beings might have been so differently constituted, as that, with reverse intuitions to our own, they might have recognised as truths what we instantly recoil from as falsehoods, or felt to be absurdities our first and foremost principles of truth. And when this suspicion is once admitted, so as to shake our confidence in the judgments of the intellect, it were but consistent

that it should be extended to the departments of both morality and taste. Our impressions of what is virtuous or of what is fair, may be regarded as alike accidental and arbitrary with our impressions of what is true—being referable to the structure of the mind, and not to any objective reality in the things which are contemplated. It is thus that the absolutely true, or good, or beautiful, may be conceived of, as having no stable or substantive being in nature; and the mind, adrift from all fixed principle, may thus lose itself in universal pyrrhonism.

9. Nature is fortunately too strong for this speculation; but still there is a comfort in being enabled to vindicate the confidence which she has inspired—as in those cases, where some original principle of hers admits of being clearly and decisively tested. And it is so of our faith in the constancy of nature, met and responded to, throughout all her dominions by nature's actual constancy—the one being the expectation, the other its rigid and invariable fulfilment. This perhaps is the most palpable instance which can be quoted, of a belief anterior to experience, yet of which experience affords a wide and unexcepted verification. It proves at least of one of our implanted instincts, that it is unerring; and that, over against a subjective tendency in the mind, there is a great objective reality in circumambient nature to which it corresponds. This may well convince us, that we live, not in a world of imaginations—but in a world of realities. It is a noble example of the harmony which obtains, between the original make and constitution of the human spirit upon the one hand, and the constitution of external things upon the other; and nobly accredits the faithfulness of Him, who, as the Creator of both, ordained this happy and wondrous adaptation. The monstrous suspicion of the sceptics is, that we are in the hands of a God, who, by the insertion of falsities into the human system, sports himself with a laborious deception on the creatures whom He hath made. The invariable order of nature, in conjunction with the apprehension of this invariableness existing in all hearts; the universal expectation with its universal fulfilment, is a triumphant refutation of this degrading mockery—evincing, that it is not a phantasmagoria in which we dwell, but a world peopled with realities. That we are never misled in our instinctive belief of nature's uniformity, demonstrates the perfect safety wherewith we may commit ourselves to the guidance of our original principles, whether intellectual or moral—assured, that, instead of occupying a land of shadows, a region of universal doubt and derision, they are the stabilities, both of an everlasting truth and an everlasting righteousness with which we have to do.

10. This lesson obtains a distinct and additional confirmation from every particular instance of adaptation, which can be found, of external nature, either to the moral or intellectual constitution of man.

11. (2.) To understand our second adaptation we must advert to the difference that obtains between those truths which are so distinct and independent, that each can only be ascertained by a separate act of observation; and those truths which are either logically or mathematically involved in each other.* For example, there is no such dependence between the colour of a flower and its smell, as that the one can be reasoned from the other; and, every different specimen therefore, we, to ascertain the two facts of the colour and the smell, must have recourse to two observations. On the other hand, there is such a dependence between the proposition that self-preservation is the strongest and most general law of our nature, and the proposition that no man will starve if able and in circumstances to work for his own maintenance—that the one proposition can be deduced by inference from the other, as the conclusion from the premises of an argument. And still more there is such a dependence between the proposition, that the planet moves in an elliptical orbit round the sun, having its focus in the centre of that luminary, and a thousand other propositions—so that without a separate observation for each of the latter, they can be reasoned from the former; just as an infinity of truths and properties can, without observation, be satisfactorily demonstrated of many a curve from the simple definition of it. We do not affirm, that, in any case, we can establish a dogma, or make a discovery independently of all observation—any more than in a syllogism we are independent of observation for the truth of the premises—both the major and the minor propositions being generally verified in this way; while the connexion between these and the conclusion, is all, in the syllogism, wherewith the art of logic has properly to do. In none of the sciences, is the logic of itself available for the purpose of discovery; and it can only contribute to this object, when furnished with sound data, the accuracy of which is determined by observation alone. This holds particularly true of the mixed mathematics, where the

* See this distinction admirably expounded in Whately's *Logic*—a work of profound judgment, and which effectually vindicates the honours of a science, that since the days of Bacon, or rather (which is more recent) since the days of his extravagant because exclusive authority, it has been too much the fashion to depreciate. The author, if I might use the expression without irreverence, has given to Bacon the things which are Bacon's, and to Aristotle the things which are Aristotle's. He has strengthened the pretensions of logic by narrowing them—that is, instead of placing all the intellectual processes under its direction, by assigning to it as its proper subject the art of deduction alone. He has made most correct distinction between the inductive and the logical; and it is by attending to the respective provinces of each, that we come to perceive the incompetency of mere logic for the purpose of discovery strictly so called. The whole chapter on discovery is particularly valuable—leading us clearly to discriminate between that which logic can, and that which it cannot achieve. It is an instrument, not for the discovery of truth properly new, but for the discovery of truths which are enveloped or virtually contained in propositions already known. It instructs but does not inform; and has nought to do in syllogism with the truth of the premises, but only with the truth of the connexion between the premises and the conclusion.

conclusions are sound, only in as far as the first premises are sound—which premises, in like manner, are not reasoned truths, but observed truths. Even in the pure mathematics, some obscurely initial or rudimental process of observation may have been necessary, ere the mind could arrive at its first conceptions, either of quantity or number. Certain it is, however, that, in all the sciences, however dependent on observation for the original data, we can, by reasoning on the data, establish an indefinite number of distinct and important and useful propositions—which, if soundly made out, observation will afterwards verify; but which, anterior to the application of this test, the mind, by its own cogitations, may have made the objects of its most legitimate conviction. It is thus that, on the one hand, we, by the inferences of a sound logic, can, on an infinity of subjects, discover what should for ever have remained unknown, had it been left to the findings of direct observation; and that, on the other hand, though observation could not have made the discovery, it never fails to attest it. Visionaries, on the one hand, may spurn at the ignoble patience and drudgery of observers; and ignorant practitioners, whether in the walks of business or legislation, may, on the other, raise their senseless and indiscriminate outcry against the reasoners—but he who knows to distinguish between an hypothesis based on imagination, and a theory based on experience, and perceives how helpless either reason or observation is, when not assisted by the other, will know how to assign the parts, and to estimate the prerogatives of both.

12. When the mind has retired from direct converse with the external world, and brought to its own inner chamber of thought the materials which it has collected there, it then delivers itself up to its own process—first ascending analytically from observed phenomena to principles, and then descending synthetically from principles to yet unobserved phenomena. We cannot but recognise it as an exquisite adaptation between the subjective and the objective, between the mental and the material systems—that the results of the abstract intellectual process and the realities of external nature should so strikingly harmonize.* It is exemplified in all the sciences, in the

* There are some fine remarks by Sir John Hershell in his preliminary discourse on the study of Natural Philosophy on this adaptation of the abstract ideas to the concrete realities, of the discoveries made in the region of pure thought to the facts and phenomena of actual nature—as when the properties of conic sections, demonstrated by a laborious analysis, remained inapplicable till they came to be embodied in the real masses and movements of astronomy.

“These marvellous computations might almost seem to have been devised on purpose to show how closely the extremes of speculative refinement and practical utility can be brought to approximate.” Hershell's Discourse, p. 28.

“They show how large a part pure reason has to perform in the examination of nature, and how implicit our reliance ought to be on that powerful and methodical system of rules and processes, which constitute the modern mathematical analysis, in all the more difficult applications of exact calculation to her phenomena.” p. 33.

economical, and the mental, and the physical, and most of all in the physico-mathematical—as when Newton, on the calculations and profound musings of his solitude, predicted the oblate spheroidal figure of the earth, and the prediction was confirmed by the mensurations of the academicians, both in the polar and equatorial regions, or as, when abandoning himself to the devices and the diagrams of his own construction, he thence scanned the cycles of the firmament, and elicited from the scroll of enigmatical characters which himself had framed, the secrets of a sublime astronomy, that high field so replete with wonders, yet surpassed by this greatest wonder of all, the intellectual mastery which man has over it. That such a feeble creature should have made this conquest—that a light struck out in the little cell of his own cogitations should have led to a disclosure so magnificent—that by a calculus of his own formation, as with the power of a talisman, the heavens, with their stupendous masses and untrodden distances, should have thus been opened to his gaze—can only be explained by the intervention of a Being having supremacy over all, and who has adjusted the laws of matter and the properties of mind to each other. It is only thus we can be made to understand, how man by the mere workings of his spirit, should have penetrated so far into the workmanship of Nature; or that, restricted though he be to a spot of earth, he should nevertheless tell of the suns and systems that be afar—as if he had travelled with the line and plummet in his hand to the outskirts of creation, or carried the torch of discovery round the universe.

13. (3.) Our next adaptation is most notably exemplified in those cases, when some isolated phenomenon, remote and having at first no conceivable relation to human affairs, is nevertheless converted by the plastic and productive intellect of man, into some application of mighty and important effect on the interests of the world. One example of this is the use that has been made of the occultations and emersions of Jupiter's satellites, in the computation of longitudes, and so the perfecting of navigation. When one contemplates a subserviency of this sort fetched to us from afar, it is difficult not to imagine of it as being the fruit of some special adjustment, that came within the purpose of Him, who, in constructing the vast mechanism of Nature, overlooked not the humblest of its parts—but incorporated the good of our species, with the wider generalities and laws of a

“Almost all the great combinations of modern mechanism and many of its refinements and nicer improvements, are creations of pure intellect, grounding its exertion upon a very moderate number of elementary propositions, in theoretical mechanics and geometry.” p. 63.

The discovery of the principle of the achromatic telescope, is termed by Sir John “a memorable case in science, though not a singular one, where the speculative geometer in his chamber, apart from the world, and existing among abstractions, has originated views of the noblest practical application.” p. 255.

universal system.* The conclusion is rather enhanced than otherwise by the seemingly incidental way in which the telescope was discovered. The observation of the polarity of the magnet is an example of the same kind—and with the same result, in multiplying, by an enlarged commerce the enjoyments of life, and speeding onward the science and civilization of the globe. There cannot a purer instance be given, of adaptation between external nature and the mind of man—than when some material, that would have remained for ever useless in the hands of the unintelligent and unthoughtful, is converted, by the fertility and power of the human understanding, into an instrument for the further extension of our knowledge or our means of gratification. The prolongation of their eyesight to the aged by the means of convex lenses, made from a

* The author of the *Natural History of Enthusiasm*, in his edition of Edward's treatise on the will, presents us with the following energetic sentences on this subject.

“Every branch of modern science abounds with instances of remote correspondences between the great system of the world, and the artificial (*the truly natural*) condition to which knowledge raises him. If these correspondences were single or rare they might be deemed merely fortuitous; like the drifting of a plank athwart the track of one who is swimming from a wreck. But when they meet us on all sides and invariably, we must be resolute in atheism not to confess that they are emanations from one and the same centre of wisdom and goodness. Is it nothing more than a lucky accommodation which makes the polarity of the needle to subserve the purposes of the mariner? or may it not safely be affirmed, both that the magnetic influence (whatever its primary intention may be) had reference to the business of navigation—a reference incalculably important to the spread and improvement of the human race; and that the discovery and the application of this influence arrived at the destined moment in the revolution of human affairs when in combination with other events, it would produce the greatest effect? Nor should we scruple to affirm that the relation between the inclination of the earth's axis and the conspicuous star which, without a near rival, attracts even the eye of the vulgar, and shows the north to the wanderer on the wilderness or on the ocean, is in like manner a beneficent arrangement. Those who would spurn the supposition that the celestial locality of a sun immeasurably remote from our system, should have reference to the accommodation of the inhabitants of a planet so inconsiderable as our own, forget the style of the Divine Works, which is, to serve some great or principal end, compatibly with ten thousand lesser and remoter interests. Man if he would secure the greater, must neglect or sacrifice the less; not so the Omnipotent Contriver. It is a fact full of meaning, that those astronomical phenomena (and so others) which offer themselves as available for the purposes of art, as for instance of navigation, or geography, do not fully or effectively, yield the end they promise, until after long and elaborate processes of calculation have disentangled them from variations, disturbing forces and apparent irregularities. To the rude fact, if so we might designate it, a mass of recondite science must be appended, before it can be brought to bear with precision upon the arts of life. Thus the polarity of the needle or the eclipses of Jupiter's moons are as nothing to the mariner, or geographer, without the voluminous commentary furnished by the mathematics of astronomy. The fact of the expansive force of steam must employ the intelligence and energy of the mechanics of an empire, during a century, before the whole of its beneficial powers can be put in activity. Chemical, medical, and botanical science is filled with parallel instances; and they all affirm, in an articulate manner, the two-fold purpose of the Creator—to benefit man and to educate him.

substance at once transparent and colourless—the force of steam with the manifold and ever growing applications which are made of it—the discovery of platina, which, by its resistance to the fiercest heats, is so available in prosecuting the ulterior researches of chemistry*—even the very abundance and portability of those materials by which written characters can be multiplied, and, through the impulse thus given to the quick and copious circulation of human thoughts, mind acts with rapid diffusion upon mind though at a distance of a hemisphere from each other, conceptions and informations and reasonings these products of the intellect alone being made to travel over the world by the intervention of material substances—these, while but themselves only a few taken at random from the multitude of strictly appropriate specimens which could be alleged of an adaptation between the systems of mind and matter, are sufficient to mark an obvious contrivance and forth-putting of skill in the adjustment of the systems to each other. Enough has been already done to prove of mind with its various powers, that it is the fittest agent which could have been employed for working upon matter; and of matter, with its various properties and combinations, that it is the fittest instrument which could have been placed under the disposal of mind. Every new triumph achieved by the human intellect over external nature, whether in the way of discovery or of art, serves to make the proof more illustrious. In the indefinite progress of science and invention, the mastery of man over the elements which surround him is every year becoming more conspicuous—the pure result of adaptation, or of the way in which mind and matter have been conformed to each other; the first endowed by the Creator with those powers which qualify it to command; the second no less evidently endowed with those corresponding susceptibilities which cause it to obey.

14. (4.) The way is now prepared for our next adaptation which hinges upon this—that the highest efforts of intellectual power, and to which few men are competent; the most difficult intellectual process, requiring the utmost abstraction and leisure for their development, and often indispensable to discoveries, which, when once made, are found capable of those useful applications, the value of which is felt and recognised by all men. The most arduous mathematics had to be put into requisition, for the establishment of the lunar theory—

* This among many such lessons will teach us that the most important uses of natural objects are not those which offer themselves to us most obviously. The chief use of the moon for man's immediate purposes remained unknown to him for five thousand years from his creation. And since it cannot but be that innumerable and most important uses remain to be discovered among the materials and objects already known to us, as well as among those which the progress of science must hereafter disclose, we may here conceive a well-grounded expectation, not only of constant increase in the physical resources of mankind, and the consequent improvement of their condition, but of continual accessions to our power of penetrating into the arcana of nature, and becoming acquainted with her highest laws. Sir John Herschell's Discourse, p. 308, 309.

without which our present lunar observations, could have been of no use for the determination of the longitude. This dependence of the popular and the practical on an anterior profound science runs through much of the business of life, in the mechanics and chemistry of manufactures as well as in navigation; and indeed is more or less exemplified so widely, or rather universally, through the various departments of human industry and art, that it most essentially contributes to the ascendancy of mind over muscular force in society—beside securing for mental qualities, the willing and reverential homage of the multitude. This peculiar influence stands complicated with other arrangements, requiring a multifarious combination, that speaks all the more emphatically for a presiding intellect, which must have devised and calculated the whole. We have already stated,* by what peculiarity in the soil it was, that a certain number of the species was exempted from the necessity of labour; and without which, in fact, all science and civilization would have been impossible. We have also expounded in some degree the principle, which both originated the existing arrangements of property, and lead men to acquiesce in them. But still it is a precarious acquiescence, and liable to be disturbed by many operating causes of distress and discontent in society. If there be influences on the side of the established order of things, there are also counteractive influences on the opposite side, of revolt and irritation against it; and by which, the natural reverence of men for rank and station, may at length be overborne. In the progress of want and demoralization among the people, in the pressure of their increasing numbers, by which, they at once outgrow the means of instruction, and bear more heavily on the resources of the land than before; in the felt straitness of their condition, and the proportionate vehemence of their aspirations after enlargement—nothing is easier than to give them a factitious sense of their wrongs, and to inspire them with the rankling imagination of a heartless and haughty indifference on the part of their lordly superiors towards them, whose very occupation of wealth, they may be taught to regard as a monopoly, the breaking down of which were an act of generous patriotism. Against these brooding elements of revolution in the popular mind, the most effectual preservative certainly, were the virtue of the upper classes,—or that our great men should be good men. But a mighty help to this, and next to it in importance were, that to the power which lies in wealth, they should superadd the power which lies in knowledge—or that the vulgar superiority of mere affluence and station, should be strengthened in a way that would command the willing homage of all spirits, that is, by the mental superiority which their opportunities of lengthened and laborious education enable them to acquire. By a wise ordination of Nature, the pos-

* Part I. c. vi. 29.

sessors of rank and fortune, simply as such, have a certain ascendant power over their fellows; and, by the same ordination, the possessors of learning have an ascendancy also—and it would mightily conduce to the strength and stability of the commonwealth, if these influences were conjoined, or, in other words, if the scale of wealth and the scale of intelligence, in as far as that was dependent on literary culture, could be made to harmonize. The constitution of science, or the adaptation which obtains between the objects of knowledge and the knowing faculties, is singularly favourable to the alliance for which we now plead—insomuch that, to sound the depths of philosophy, time and independence and exemption from the cares and labours of ordinary life seem indispensable; and, on the other hand, profound discoveries, or a profound acquaintance with them, are sure to command a ready deference even from the multitude, whether on account of the natural respect which all men feel for pre-eminent understanding, or on account of the palpable utilities to which, in a system of things so connected as ours, even the loftiest and most recondite science is found to be subservient. On the same principle, that, in a ship, the skilful navigation of its captain will secure for him the prompt obedience of the crew to all his directions;* or that, in an army, the consummate generalship of its commander will subordinate all the movements of the immense host, to the power of one controlling and actuating will—so, in general society, did wealth by means of a thorough scholarship

* We have before us an anecdote communicated to us by a naval officer, (Captain Basil Hall,) distinguished for the extent and variety of his attainments, which shows how impressive such results may become in practice. He sailed from San Blas on the west coast of Mexico, and after a voyage of 8000 miles, occupying eighty-nine days, arrived off Rio Janeiro, having in this interval passed through the Pacific Ocean, rounded Cape Horn, and crossed the South Atlantic, without making any land, or even seeing a single sail, with the exception of an American whaler off Cape Horn. Arrived within a week's sail of Rio, he set seriously about determining, by lunar observations, the precise line of the ship's course, and its situation in it at a determinate moment, and having ascertained this within from five to ten miles, ran the rest of the way by those more ready and compendious methods, known to navigators, which can be safely employed for short trips between one known point and another, but which cannot be trusted in long voyages, where the moon is their only guide. The rest of the tale we are enabled by his kindness to state in his own words:—"We steered towards Rio Janeiro for some days after taking the lunars above described, and having arrived within fifteen or twenty miles of the coast, I hove-to till four in the morning when the day should break, and then bore up; for although it was very hazy, we could see before us a couple of miles or so. About eight o'clock it became so foggy that I did not like to stand in farther, and was just bringing the ship to the wind again before sending the people to breakfast, when it suddenly cleared off, and I had the satisfaction of seeing the great sugar-loaf peak, which stands on one side of the harbour's mouth, so nearly right a-head that we had not to alter our course above a point, in order to hit the entrance of Rio. This was the first land we had seen for three months, after crossing so many seas, and being set backwards and forwards by innumerable currents and foul winds." "The effect on all on board might well be conceived to have been electric; and it is needless to remark how essentially the authority of a command-

on the part of the higher classes, but maintain an intimate fellowship with wisdom and sound philosophy—then, with the same conservative influence as in these other examples, would the intellectual ascendancy thus acquired, be found of mighty effect, to consolidate and maintain all the gradations of the commonwealth.

15. It is thus that a vain and frivolous aristocracy, averse to severe intellectual discipline, and beset with the narrow prejudices of an order, let themselves down from that high vantage-ground on which fortune hath placed them—where, by a right use of the capabilities belonging to the state in which they were born, they might have kept their firm footing to the latest generations. Did all truth lie at the surface of observation, and it was alike accessible to all men, they could not with such an adaptation of external nature to man's intellectual constitution, have realised the peculiar advantage on which we are now insisting. But it is because there is so much of important and applicable truth, which lies deep and hidden under the surface, and which can only be appropriated by men, who combine unbounded leisure with the habit or determination of strenuous mental effort—it is only because of such an adaptation, that they who are gifted with property are, as a class, gifted with the means, if they would use it, of a great intellectual superiority over the rest of the species. There is a strong natural veneration for wealth, and also a strong natural veneration for wisdom. It is by the union of the two that the horrors of revolutionary violence, might for ever be averted from the land. Did our high-born children of affluence, for every ten among them, the mere loungers of effeminacy and fashion, or the mere lovers of sport and sensuality and splendour—did they, for every ten of such, furnish but one enamoured of higher gymnastics, the gymnastics of the mind; and who accomplished himself for the work and warfare of the senate, by his deep and comprehensive views in all the proper sciences of a statesman, the science of government, and politics, and commerce, and economics, and history, and human nature,—by a few gigantic men among them, thus girded for the services of patriotism, a nation might be saved—because arrested on that headlong descent, which, at the impulse of the popular will, it might else have made, from one measure of fair but treacherous promise, from one ruinous plausibility to another. The thing most to be dreaded, is that hasty and superficial legislation, into which a government may be hurried by the successive onsets of public impatience, and under the impulse

ing officer over his crew may be strengthened by the occurrence of such incidents, indicative of a degree of knowledge and consequent power beyond their reach.”—Herschell's Discourse, p. 28, 29.

It is an extreme instance of the connexion between mental power and civil or political ascendancy, though often verified in the history of the world—that military science has often led to the establishment of a military despotism.

of a popular and prevailing cry. Now the thing most needed, as a counteractive to this evil, is a thoroughly intellectual parliament, where shall predominate that masculine sense which has been trained for act and application by masculine studies; and where the silly watch-word of theory shall not be employed, as heretofore, to overbear the lessons of soundly generalised truth—because instead of being discerned at a glance, they are fetched from the depths of philosophic observation, or shone upon by lights from afar, in the accumulated experience of ages. We have infinitely more to apprehend from the demagogues than from the doctrinaires of our present crisis; and it will require a far profounder attention to the principles of every question than many deem to be necessary, or than almost any are found to bestow, to save us from the crudities of a blindfold legislation.*

16. And it augurs portentously for the coming destinies of our land, that, in the present rage for economy, such an indiscriminate havoc should have been made—so that pensions and endowments for the reward or encouragement of science, should have had the same sentence of extinction passed upon them, as the most worthless sinecures. The difficulties of our most sublime, and often too

* This mental superiority which the higher classes might and ought to cultivate, is not incompatible, but the contrary, with a general ascent in the scholarship of the population at large. On this subject we have elsewhere said—that “there is a bigotry on the side of endowed seminaries which leads those whom it actuates to be jealous of popular institutions. And, on the other hand, there is a generous feeling towards these institutions, which is often accompanied with a certain despite towards the endowed and established seminaries. We think that a more comprehensive consideration of the actings and reactions which take place in society, should serve to abate the heats of this partisanship, and that what in one view is regarded as the conflict of jarring and hostile elements, should, in another, be rejoiced in as a luminous concourse of influences, tending to accomplish the grand and beneficent result of an enlightened nation. It is just because we wish so well to colleges, that we hail the prosperity of mechanic institutions. The latter will never outrun the former, but so stimulate them onwards, that the literature of our higher classes shall hold the same relative advancement as before over the literature of our artisans. It will cause no derangement and no disproportion. The light which shall then overspread the floor of the social edifice, will only cause the lustres which are in the higher apartments to blaze more gorgeously. The basement of the fabric will be greatly more elevated, yet without violence to the symmetry of the whole architecture; for the pinnacles and upper stories of the building will rise as proudly and as gracefully as ever above the platform which sustains them. There is indefinite room in truth and science for an ascending movement, and the taking up of higher positions; and if, in virtue of a popular philosophy now taught in schools of art, we are to have more lettered mechanics, this will be instantly followed up by a higher philosophy in colleges than heretofore; and in virtue of which we shall also have a more accomplished gentry, a more intellectual parliament, a more erudite clergy, and altogether a greater force and fullness of mind throughout all the departments of the commonwealth. The whole of society will ascend together, and therefore without disturbance to the relation of its parts. But, in every stage of this progress, the endowed colleges will continue to be the highest places of intellect; the country's richest lore and its most solid and severest philosophy will always be found in them.” *Use and Abuse of Literary and Ecclesiastical Endowments.*

our most useful knowledge, make it inaccessible to all but to those who are exempt from the care of their own maintenance—so that unless a certain, though truly insignificant portion of the country's wealth, be expended in this way, all high and transcendental philosophy, however conducive as it often is, to the strength as well as glory of a nation must vanish from the land. When the original possessors of wealth neglect individually this application of it; and, whether from indolence or the love of pleasure, fall short of that superiority in mental culture, of which the means have been put into their hands—we can only reproach their ignoble preference, and lament the ascendant force of sordid and merely animal propensities, over the principles of their better and higher nature. But when that which individuals do in slavish compliance with their indolence and passions, the state is also found to do in the exercise of its deliberative wisdom, and on the maxims of a settled policy—when instead of ordaining any new destination of wealth in favour of science, it would divorce and break asunder the goodly alliance by a remorseless attack on the destinations of wiser and better days—such a gothic spoliation as this, not a deed of lawless cupidity but the mandate of a senate-house, were a still more direct and glaring contravention to the wisdom of Nature, and to the laws of that economy which Nature hath instituted. The adaptation of which we now speak, between the external system of the universe, and the intellectual system of man, were grossly violated by such an outrage; and it is a violence which Nature would resent by one of those signal chastisements, the examples of which are so frequent in history. The truth is that, viewed as a manifestation of the popular will, which tumultuates against all that wont to command the respect and admiration of society, and is strong enough to enforce its dictations—it may well be regarded, as one of the deadliest symptoms of a nation ripening for anarchy, that dread consummation, by which, however, the social state, relieved of its distempers, is at length renovated like the atmosphere by a storm, after throwing off from it, the dregs and the degeneracy of an iron age.*

17. (5.) We shall do little more than state two other adaptations, although more might be noticed, and all do admit of a much fuller elucidation than we can bestow upon them. And first, there is a countless diversity of sciences, and correspondent to this, a like diversity in the tastes and talents of men, presenting, therefore, a most beneficial adaptation, between the objects of human knowledge and the powers of human knowledge. Even in one science there are often many subdivisions, each requiring a separate mental fitness, on the part of those, who might select it as their own favourite walk, which they most love, and in which they are best qualified to excel.

* The same effect is still more likely to ensue from the spoliation and secularization of ecclesiastical property.

In most of the physical sciences, how distinct the business of the observation is from that of the philosophy; and how important to their progress, that, for each appropriate work, there should be men of appropriate faculties or habits, who in the execution of their respective tasks, do exceedingly multiply and enlarge the products of the mind—even as the grosser products of human industry are multiplied by the subdivision of employment.* It is well, that, for that infinite variety of intellectual pursuits, necessary to explore all the recesses of a various and complicated external nature, there should be a like variety of intellectual predilections and powers scattered over the species—a congruity between the world of mind and the world of matter, of the utmost importance, both to the perfecting of art, and to the progress and perfecting of science. Yet it is marvellous of these respective labourers, though in effect they work simultaneously and to each other's hands, how little respect or sympathy, or sense of importance, they have for any department of the general field, for any section in the wide encyclopædia of human learning, but that on which their own faculties are concentrated and absorbed. We cannot imagine aught more dissimilar and uncongenial, than the intentness of a mathematician on his demonstrations and diagrams, and the equal intentness, nay delight, of a collector or antiquarian on the faded manuscripts and uncial characters of other days. Yet in the compound result of all these multiform labours, there is a goodly and sustained harmony, between the practitioners and the theorists of science, between the pioneers and the monarchs of literature—even as in the various offices of a well-arranged household, although there should be no mutual intelligence between the subordinates who fill them, there is a supreme and connecting wisdom which presides over and animates the whole. The goodly system of philosophy, when viewed as the product of innumerable contributions, by minds of all possible variety, and men of all ages—bears like evidence to the universe being a spacious household, under the one and consistent direction of Him who is at once the Parent and the Master of a universal family.†

18. And here it is not out of place to remark, that it is the very perfection of the Divine workmanship, which leads every inquirer to imagine a surpassing worth and grace and dignity in his own special department of it. The fact is altogether notorious, that in order to attain a high sense of the importance of any science, and

* There is no accounting for the difference of minds or inclinations, which leads one man to observe with interest the development of phenomena, another to speculate on their causes; but were it not for this happy disagreement, it may be doubted whether the higher sciences could ever have attained even their present degree of perfection." Sir John Herschell's Discourses, p. 131.

† The benefit of subdivision in science should lead to the multiplication of professorships in our literary institutes, and at all events should prevent the parsimonious suppression of them, or the parsimonious amalgamation of the duties of two or more into one.

of the worth and beauty of the objects which it embraces—nothing more is necessary than the intent and persevering study of them. Whatever the walk of philosophy may be on which man shall enter, that is the walk which of all others he conceives to be most enriched, by all that is fitted to entertain the intellect, or arrest the admiration of the enamoured scholar. The astronomer who can unravel the mechanism of the heavens, or the chemist who can trace the atomic processes of matter upon earth, or the metaphysician who can assign the laws of human thought, or the grammarian who can discriminate the niceties of language, or the naturalist who can classify the flowers and the birds, and the shells and the minerals and the insects which so teem and multiply in this world of wonders—each of these respective inquirers is apt to become the worshipper of his own theme, and to look with a sort of indifference, bordering on contempt, towards what he imagines the far less interesting track of his fellow-labourers. Now each is right in the admiration he renders to the grace and grandeur of that field which himself has explored; but all are wrong in the distaste they feel, or rather in the disregard they cast on the other fields which they have never entered. We should take the testimony of each to the worth of that which he does know, and reject the testimony of each to the comparative worthlessness of that which he does not know; and then the unavoidable inference is that that must be indeed a replete and a gorgeous universe in which we dwell—and still more glorious the Eternal Mind, from whose conception it arose, and whose prolific fiat gave birth to it, in all its vastness and variety. And instead of the temple of science having been reared, it were more proper to say, that the temple of nature had been evolved. The archetype of science is the universe; and it is in the disclosure of its successive parts, that science advances from step to step—not properly raising any new architecture of its own, but rather unveiling by degrees an architecture that is old as the creation. The labourers in philosophy create nothing; but only bring out into exhibition that which was before created. And there is a resulting harmony in their labours, however widely apart from each other they may have been prosecuted—not because they have adjusted one part to another, but because the adjustment has been already made to their hands. There comes forth, it is true, of their labours, a most magnificent harmony, yet not a harmony which they have made, but a pre-existent harmony which they have only made visible—so that when tempted to idolize philosophy, let us transfer the homage to Him who both formed the philosopher's mind, and furnished his philosophy with all its materials.

19. (6.) The last adaptation that we shall instance is rather one of mind to mind, and depends on a previous adaptation in each mind of the mental faculties to one another. For the right working of the mind, it is not enough that each of its separate powers shall be

provided with adequate strength—they must be mixed in a certain proportion—for the greatest inconvenience might be felt, not in the defect merely, but in the excess of some of them. We have heard of too great a sensibility in the organ of hearing, giving rise to an excess in the faculty, which amounted to disease, by exposing the patient to the pain and disturbance of too many sounds, even of those so faint and low, as to be inaudible to the generality of men. In like manner we can imagine the excess of a property purely mental, of memory for example, amounting to a malady of the intellect, by exposing the victim of it to the presence and the perplexity of too many ideas, even of those which are so insignificant, that it would lighten and relieve the mind, if they had no place there at all.* Certain it is that the more full and circumstantial is the memory, the more is given for the judgment to do—its proper work of selecting and comparing becoming the more oppressive, with the number and distraction of irrelevant materials. It would have been better that these had found no original admittance within the chamber of recollection; or that only things of real and sufficient importance had left an enduring impression upon its tablet. In other words, it would have been better, that the memory had been less susceptible or less retentive than it is; and this may enable us to perceive the exquisite balancing that must have been requisite, in the construction of the mind—when the very defect of one faculty is thus made to aid and to anticipate the operations of another. He who alone knoweth the secrets of the spirits, formed them with a wisdom to us unsearchable.

20. Certain it is however that variety in the proportion of their faculties, is one chief cause of the difference between the minds of men. And whatever the one faculty may be, in any individual, which predominates greatly beyond the average of the rest—that faculty is selected as the characteristic by which to distinguish him; and thus he may be designed as a man of judgment, or information, or fancy, or wit, or oratory. It is this variety in their respective gifts, which originates so beautiful a dependence and reciprocity of mutual services among men; and, more especially, when any united movement or united counsel is requisite, that calls forth the co-operation of numbers. No man combines all the ingredients of mental power; and no man is wanting in all of them—so that, while none is wholly independent of others, each possesses some share of importance in the commonwealth. The defects, even of the highest minds, may thus need to be supplemented, by the counterpart excellencies

* It has been said of Sir James Mackintosh, that the excess of his memory was felt by him as an incumbrance in the writing of history—adding as it did to the difficulty of selection. It is on the same principle that the very multitude of one's ideas and words may form an obstacle to extemporaneous speaking, as has been illustrated by Dean Swift under the comparison of a thin church emptying faster than a crowded one.

of minds greatly inferior to their own—and, in this way, the pride of exclusive superiority is mitigated; and the respect which is due to our common humanity is more largely diffused throughout society, and shared more equally among all the members of it. Nature hath so distributed her gifts among her children, as to promote a mutual helpfulness, and, what perhaps is still more precious, a mutual humility among men.

21. In almost all the instances of mental superiority, it will be found, that it is a superiority above the average level of the species, in but one thing—or that arises from the predominance of one faculty above all the rest. So much is this the case, that when the example does occur, of an individual, so richly gifted as to excel in two of the general or leading powers of the mind, his reputation for the one will impede the establishment of his reputation for the other. There occurs to us one very remarkable case of the injustice, done by the men who have but one faculty, to the men who are under the misfortune of having two. In the writings of Edmund Burke, there has at length been discovered, a rich mine of profound and strikingly just reflections, on the philosophy of public affairs. But he felt as well as thought, and saw the greatness and beauty of things, as well as their relations; and so, he could at once penetrate the depths, and irradiate the surface of any object that he contemplated. The light which he flung from him, entered the very innermost shrines and recesses of his subject; but then it was light tinged with the hues of his own brilliant imagination, and many gazing at the splendour, recognised not the weight and the wisdom underneath. They thought him superficial, but just because themselves arrested at the surface; and either because with the capacity of emotion but without that of judgment, or because with the capacity of judgment but without that of emotion—they, from the very meagreness and mutilation of their own faculties, were incapable of that complex homage, due to a complex object which had both beauty and truth for its ingredients. Thus it was that the very exuberance of his genius, injured the man, in the estimation of the pigmies around him; and the splendour of his imagination detracted from the credit of his wisdom. Fox had the sagacity to see this; and posterity now see it. Now that, instead of a passing meteor, he is fixed by authorship in the literary hemisphere, men can make a study of him; and be at once regaled by the poetry, and instructed by the profoundness of his wondrous lucubrations.

CHAPTER II.

On the Connexion between the Intellect and the Emotions.

1. THE intellectual states of the mind, and its states of emotion, belong to distinct provinces of the mental constitution—the former to the percipient, and the latter to what Sir James Mackintosh would term the *emotive* or *pathematic* part of our nature. Bentham applies the term *pathology* to the mind in somewhat the same sense—not expressive, as in medical science, of states of disease, under which the body suffers; but expressive, in mental science, of states of susceptibility, under which the mind is in any way affected, whether painfully or pleurably. Had it not been for the previous usurpation or engagement of this term by medical writers, who restrict the application of it to the distempers of our corporeal frame, it might have been conveniently extended to all the susceptibilities of the mental constitution—even when that constitution is in its healthful and natural state. According to the medical use of it, the Greek $\pi\alpha\sigma\chi\omega$ from which it is derived, is understood in the sense of the Latin translation, *patior*, to suffer. According to the sense which we now propose for it, in treating the mental phenomena, the Greek $\pi\alpha\sigma\chi\omega$ would be understood in the sense of the Latin translation *afficio* to be affected. When treating of the mental pathology, we treat, not of mental sufferings, but, more general, of mental susceptibilities. The $\pi\alpha\sigma\chi\omega$ of the Greek, whence the term comes, is equivalent to the “*patior*” or the “*afficio*” of Latin,—the former signifying “to suffer;” and the latter simply “to be affected,—the former sense being the one that is retained in medical, and the latter in mental pathology. The two differ as much the one from the other as passion does from affection, or the violence of a distempered does from the due and pacific effect of a natural influence. Even the Latin *patior* might be translated, not merely into “suffer” but into “the being acted upon” or into “the being passive.” Medical pathology is the study of those diseases under which the body suffers. Mental pathology is the study of all those phenomena that arise from influences acting upon the mind viewed as passive, or as not putting forth any choice or activity at the time. Now, when thus defined, it will embrace all that we understand by sensations, and affections, and passions. It is not of my will that certain colours impress their appropriate sensations upon my eye, or that certain sounds impress their sensations upon my ear. It is not of my will, but of an organization which I often cannot help, that I am so nervously irritable, under certain disagreeable sights and disagreeable noises. It is not of my will, but of an aggressive influence which I cannot withstand, that, when placed on an airy summit,

I forthwith swim in giddiness, and am seized with the imagination, that if I turn not my feet and my eyes from the frightful precipice's margin, I shall topple to its base. Neither is it of my will that I am visited with such ineffable disgust at the sight of some loathsome animal. But these are strong instances, and perhaps evince a state bordering upon disease. Yet we may gather from them some general conception of what is meant by mental pathology, whose design it is to set forth all those states of feeling, into which the mind is thrown, by the influence of those various objects that are fitted to excite, either the emotions or the sensitive affections of our nature. And, to keep the subject of mental pathology pure, we shall suppose these states of feeling to be altogether unmodified by the will, and to be the very states which result from the law of the external senses, or the laws of emotion, operating upon us at the time, when the mind is either wholly powerless or wholly inactive. To be furnished with one comprehensive term, by which to impress a mark on so large an order of phenomena, must be found very commodious; and though we have adverted to the etymology of the term, yet, in truth, it is of no consequence whether the process of derivation be accurate or not—seeing that the most arbitrary definition, if it only be precise in its objects, and have a precisely expressed sense affixed to it, can serve all the purposes for which a definition is desirable.

2. The emotions enter largely into the pathological department of our nature. They are distinguishable both from the appetites and the external affections, in that they are mental and not bodily—though, in common with these, they are characterised by a peculiar vividness of feeling, which distinguishes them from the intellectual states of the mind. It may not be easy to express the difference in language; but we never confound them in specific interests—being at no loss to which of the two classes we should refer the acts of memory and judgment; and to which we should refer the sentiments of fear, or gratitude, or shame, or any of the numerous affections and desires of which the mind is susceptible.

3. The first belonging to this class that we shall notice is the desire of knowledge, or the principle of curiosity—having all the appearance and character of a distinct and original tendency in the mind, implanted there for the purpose to which it is so obviously subservient. This principle evinces its reality and strength in very early childhood, even anterior to the faculty of speech—as might be observed in the busy manipulations and exploring looks of the little infant, on any new article that is placed within its reach; and afterwards, by its importunate and never-ending questions. It is this avidity of knowledge which forms the great impellent to the acquisition of it—being in fact the hunger of the mind, and strikingly analogous to the corresponding bodily appetite, in those respects, by which each is manifested, to be the product of a higher wisdom

than ours, the effect of a more providential care than man would have taken of himself. The corporeal appetency seeks for food as its terminating object, without regard to its ulterior effect in the sustaining of life. The mental appetency seeks for knowledge, the food of the mind, as its terminating object, without regard to its ulterior benefits, both in the guidance of life, and the endless multiplication of its enjoyments. The prospective wisdom of man could be trusted with neither of these great interests; and so the urgent appetite of hunger had to be provided for the one, and the like urgent principle of curiosity had to be provided for the other. Each of them bears the same evidence of a special contrivance for a special object—and that by one who took a more comprehensive view of our welfare, than we are capable of taking for ourselves; and made his own additions to the mechanism, for the express purpose of supplementing the deficiency of human foresight. The resemblance between the two cases goes strikingly to demonstrate, how a mental constitution might as effectually bespeak the hand of an intelligent Maker, as does a physical or material constitution. It is true, that, with the great majority of men, the intellectual is not so urgent or imperious, as is the animal craving. But even for this difference, we can perceive a reason, which would not have been found, under a random economy of things. Each man's hunger would need to be alike strong, or at least strong enough to ensure the taking of food for himself—for to this effect, he will receive no benefit from another man's hunger. But there is not the same reason why each man's curiosity should be alike strong—for the curiosity of one man might subserve the supply of information and intellectual food to the rest of the species. To enlarge the knowledge of the world, it is not needed, that all men should be endowed with such a strength of desire for it, as to bear them onward through the toils of original investigation. The dominant, the aspiring curiosity, which impels the adventurous traveller to untrodden regions, will earn discoveries, not for himself alone, but for all men—if their curiosity be but strong enough for the perusal of his agreeable record, under the shelter, and amid the comforts of their own home. And it is so in all the sciences. The unquenchable thirst of a few, is ever drawing supplies of new truth, which are shared in by thousands. There is an obvious meaning in this variety, between the stronger curiosity of the few who discover truth, and the weaker curiosity of the many who acquire it. The food which hunger impels man to take, is for his own aliment alone. The fruit of that study to which the strength of his own curiosity impels him, may become the property of all men.

4. But, apart from this singularity, we behold in curiosity, viewed as a general attribute, a manifest adaptation to the circumstances in which man is placed. If, on the one hand, we look to the rich and exhaustless variety of truth, in a universe fraught with the materials

of a most stupendous and overgrowing philosophy, and each department of which is fitted to stimulate and regale the curiosity of the human mind—we should say of such an external nature as this, that, presenting a most appropriate field to the inquisitive spirit of our race, it was signally adapted to the intellectual constitution of man. Or if, on the other hand, besides looking to the world as a theatre for the delightful entertainment of our powers, we behold it, in the intricacy of its phenomena and laws, in its recondite mysteries, in its deep and difficult recesses yet conquerable to an indefinite extent by the perseverance of man, and therefore as a befitting theatre for the busy and most laborious exercise of his powers—we should say of such an intellectual constitution as ours, that it was signally adapted to the system of external nature. It would require a curiosity as strong and steadfast as Nature hath given us, to urge us onward, through the appalling difficulties of a search so laborious. Hunger is the great impellent to corporeal labour, and the gratification of this appetite is its reward. Curiosity is a great impellent to mental labour, and, whether we look to the delights or the difficulties of knowledge, we cannot fail to perceive, that this mental appetency in man, and its counterpart objects in Nature, are suited with marvellous exactness to each other.

5. But the analogy between the mental and the corporeal affections does not stop here. The appetite of hunger would, of itself, impel to the use of food—although no additional pleasure had been annexed to the use of it, in the gratifications of the palate. The sense of taste, with its various pleasurable sensations, has ever been regarded, as a distinct proof of the benevolence and care of God. And the same is true of the delights which are felt by the mind, in the acquisition of knowledge—as when truth discloses her high and hidden beauties to the eye of the enraptured student; and he breathes an ethereal satisfaction, having in it the very substance of enjoyment, though the world at large cannot sympathise with it. The pleasures of the intellect, though calm, are intense: insomuch, that a life of deep philosophy were a life of deep emotion, when the understanding receives of its own proper aliment—having found its way to those harmonies of principle, those goodly classifications of phenomena, which the disciples of science love to gaze upon. And the whole charm does not lie in the ultimate discovery. There is a felt triumph in the march, and along the footsteps of the demonstration which leads to it; and in the successive evolutions of the reasoning, as well as its successful conclusion. Like every other enterprise of man, there is a happiness in the current and continuous pursuit, as well as in the final attainment—as every student in geometry can tell, who will remember, not only the delight he felt on his arrival at the landing-place, but the delight he felt when guided onward by the traces and concatenations of the pathway. Even in the remotest abstractions of contemplative truth, there is a glory

and a transcendental pleasure, which the world knoweth not; but which becomes more intelligible, because more embodied, when the attention of the inquirer is directed to the realities of the substantive nature. And though there be few who comprehend or follow Newton in his gigantic walk, yet all may participate in his triumphant feeling, when he reached the lofty summit, where the whole mystery and magnificence of Nature stood submitted to his gaze—an eminence won by him through the power and the patience of intellect alone; but from which he descried a scene more glorious far than imagination could have formed, or than ever had been pictured and set forth, in the sublimest visions of poetry.

6. It is thus that while the love of beauty, operating upon the susceptible imagination of the theorist, is one of those seducing influences, which lead men astray from the pursuit of experimental truth—he, in fact, who at the outset resists her fascinations, because of his supreme respect for the lessons of observation, is at length repaid by the discoveries and sights of a surpassing loveliness. The inductive philosophy began its career, by a renunciation, painful we have no doubt at first to many of its disciples, of all the systems and harmonies of the schoolmen. But in the assiduous prosecution of its labours it worked its way to a far nobler and more magnificent harmony at the last—to the real system of the universe more excellent than all the schemes of human conception—not in the solidity of its evidence alone, but as an object of tasteful contemplation. The self-denial which is laid upon us by Bacon's philosophy, like all other self-denial whether in the cause of truth or virtue, hath its reward. In giving ourselves up to its guidance, we have often to quit the fascinations of beautiful theory; but in exchange for these, are at length regaled by the higher and substantial beauties of actual nature. There is a stubbornness in facts before which the specious ingenuity is compelled to give way; and perhaps the mind never suffers more painful laceration, than when, after having vainly attempted to force nature into a compliance with her own splendid generalizations, she, on the appearance of some rebellious and impracticable phenomenon, has to practise a force upon herself, when she thus finds the goodly speculation superseded by the homely and unwelcome experience. It seemed at the outset a cruel sacrifice, when the world of speculation, with all its manageable and engaging simplicities had to be abandoned; and, on becoming the pupils of observation, we, amid the varieties of the actual world around us, felt as if bewildered, if not lost among the perplexities of a chaos. This was the period of greatest sufferance, but it has had a glorious termination. In return for the assiduity wherewith the study of nature hath been prosecuted, she hath made a more abundant revelation of her charms. Order hath arisen out of confusion; and, in the ascertained structure of the universe, there are now found to be a state and a sublimity, beyond all that ever was pictured by the

mind, in the days of her adventurous and unfettered imagination. Even viewed in the light of a noble and engaging spectacle for the fancy to dwell upon, who would ever think of comparing with the system of Newton, either that celestial machinery of Des Cartes, which was impelled by whirlpools of ether, or that still more cumbersome machinery of cycles and epicycles which was the progeny of a remoter age! It is thus that after a commencement of this observational process, there is an abjuration of beauty. But it soon reappears in another form, and brightens as we advance; and there at length arises, on solid foundation, a fairer and a goodlier system, than ever floated in airy romance before the eye of genius.* Nor is it difficult to perceive the reason of this. What we discover by observation, is the product of the divine imagination—bodied forth by creative power, into a stable and enduring universe. What we devise by our own ingenuity is but the product of human imagination. The one is the solid archetype of those conceptions which are in the mind of God. The other is the shadowy representation of those conceptions which are in the mind of man. It is even as with the labourer, who, by excavating the rubbish which hides and besets some noble architecture, does more for the gratification of our taste, than if, with his unpractised hand, he should attempt to regale us by plans and sketches of his own. And so the drudgery of experimental science, in exchange for that beauty, whose fascinations it resisted at the outset of its career, has evolved a surpassing beauty from among the realities of truth and nature. The pain of the initial sacrifice is nobly compensated at the last. The views contemplated through the medium of observation, are found, not only to have a justness in them, but to have a grace and a grandeur in them, far above all the visions which are contemplated through the medium of fancy, or which ever regaled the fondest enthusiast in the enraptured walks of speculation and poetry. But the toils of investigation must be endured first, that the grace and the grandeur might be enjoyed afterwards. The same is true of science in all its departments, not of simple and sublime astronomy alone, but throughout of terrestrial physics; and most of all in chemistry, where the internal processes of actual and ascertained Nature are found to possess a beauty, which far surpasses the crude though specious plausibilities of other days. We perceive in this too, a fine adapta-

* In the "Essays of John Sheppard,"—a work very recently published, and alike characterised by the depth of its Christian intelligence and feeling, and the beauty of its thoughts—there occurs the following passage, founded on the Manuscript Notes taken by the author, of Playfair's Lectures. "It was impressively stated in a preliminary lecture by a late eminent Scotch Professor of Natural Philosophy, that the actual physical wonders of creation far transcend the boldest and most hyperbolic imaginings of poetic minds; 'that the reason of Newton and Galileo took a sublimer flight than the fancy of Milton and Ariosto.' That this is quite true I need only refer you to a few astronomical facts glanced at in subsequent pages of this volume in order to evince." Sheppard's Essays, p. 69.

tion of the external world to the faculties of man ; a happy ordination of Nature by which the labour of the spirit is made to precede the luxury of the spirit, or every disciple of science must strenuously labour in the investigation of its truths, ere he can luxuriate in the contemplation of its beauties. It is by the patient seeking of truth first, that the pleasures of taste and imagination are superadded to him. For, in these days of stern and philosophic hardihood, nothing but evidence, strict and scrutinized and thoroughly sifted evidence, will secure acceptance for any opinion. Whatever its authority, whatever its engaging likelihood may be, it must first be made to undergo the freest treatment from human eyes and human hands. It is at one time stretched on the rack of an experiment. At another it has to pass through fiery trials in the bottom of a crucible. At another, it has to undergo a long questionary process among the fumes, and the filtrations, and the intense heat of a laboratory ; and, not till it has been subjected to all this inquisitorial torture and survived it, is it preferred to a place in the temple of truth, or admitted among the laws and the lessons of a sound philosophy.

7. But, beside those rewards and excitements to science which lie in science itself, as the curiosity which impels to the prosecution of it, and the delights of prosperous study, and the pleasures that immediately spring from the contemplation of its objects—besides these, there is a remoter but not less powerful influence, and to which indeed we owe greatly more than half the philosophy of our world. We mean the respect in which high intellectual endowments are held by general society. We are not sure but that the love of fame has been of more powerful operation, in speeding onward the march of discovery, than the love of philosophy for the sake of its own inherent charms ; and there are thousands of our most distinguished intellectual labourers, who but for an unexpected harvest of renown, would never have entered on the secret and solitary prosecution of their arduous walk. We are abundantly sensible, that this appetency for fame may have helped to vulgarise both the literature and science of the country ; that men, capable of the most attic refinement in the one, may, for the sake of a wider popularity, have descended to verbiage and the false splendour of a meretricious eloquence ; and that men, capable of the deepest research and purest demonstration in the other, may, by the same unworthy compliance with the flippancy of the public taste, have exchanged the profound argument for the showy and superficial illustration—preferring to the homage of the exalted few, the attendance and plaudits of the multitude. It is thus, that, when access to the easier and lighter parts of knowledge has been suddenly enlarged, the heights of philosophy may be abandoned for a season—the man who went to occupy there, being tempted to come down from their elevation, and hold converse with that increasing host, who have entered within the precincts, and now throng the outer courts of the temple. It is

thus, that at certain transition periods, in the intellectual history of the species, philosophy may sustain a temporary depression—from which when she recovers, we shall combine, with the inestimable benefit of a more enlightened commonality, both the glory and the substantial benefit of as cultured a literature and as lofty and elaborate a philosophy as before. And we greatly mistake, if we think, that in those minds of nobler and purer ambition, the love of fame is extinguished, because they are willing to forego the bustling attendance and the clamorous applauses of a crowd. They too are intensely set on praise, but it must be such praise as that of Atticus, ‘the incense of which, though not copious, is exquisite—that precious aroma, which fills not the general atmosphere, but by which the few and the finer spirits of our race are satisfied. Theirs is not the broad day-light of popularity. It is a fame of a higher order, upheld by the testimony of the amateurs or the *élite* in science, and grounded on those rare achievements which the public at large can neither comprehend nor sympathize with. “They sit on a hill apart,” and there breathe of an ethereal element, in the calm brightness of an upper region, rather than in that glare and gorgeousness by which the eye of the multitude is dazzled. It is not the eclat of a bonfire for the regaling of a mob, but the enduring though quiet lustre of a star. The place which they occupy is aloft in the galaxy of a nation’s literature, where the eyes of the more finely intellectual gaze upon them with delight, and the hearts only of such are lighted up in reverence and *con amore* towards them. Theirs is a high though hidden praise, flowing in secret course through the *savans* of a community, and felt by every true academic to be his most appropriate reward.’*

8. The emotions of which we have yet spoken stand connected, either in the way of cause or of consequence, with the higher efforts of the intellect—as the curiosity which prompts to these efforts, and the delights attendant on the investigation and discovery of truths which reward them; beside the grateful incense of those praises, whether general or select, that are awarded to mental superiority, and form perhaps the most powerful incitement to the arduous and sustained prosecution of mental labour. But there is a connexion of another sort, between the emotions and the intellect, of still higher importance—because of the alliance which it establishes between the intellectual and the moral departments of our nature. We often speak of the pleasure that we receive from one class of the emotions, as those of taste—of the danger or disagreeableness of another, as anger or fear or envy—of the obligation that lies upon us to cherish and retain certain other emotions, insomuch that the designation of virtuous is generally given to them, as gratitude, and compassion, and the special love of relatives or country, and in one

* Use and Abuse of Literary and Ecclesiastical Endowments, p. 165—166.

word, all the benevolent affections of our nature. Now, however obvious when stated, it is not sufficiently adverted to, even when studying the philosophy of the subject, and still less in the practical government and relation of the heart—that, for the very being of each of these specific emotions in the heart, there must a certain appropriate and counterpart object, whether through the channel of sense or of the memory, be present to the thoughts. We can only feel the emotion of beauty, in the act of beholding or conceiving a beautiful object; an emotion of terror, in the view of some danger which menaces us; an emotion of gratitude, in the recollection of a past kindness, or of the benefactor who conferred it. Such then is the necessary dependence between perception and feeling, that, without the one, the other cannot possibly be awakened. Present an object to the view of the mind, and the emotion suited to that object, whether it be love, or resentment, or terror, or disgust, must consequently arise; and with as great sureness, as, on presenting visible things of different colour to the eye, the green and red, and yellow and blue impress their different and peculiar sensations on the retina. It is very obvious, that the sensations owe their being to the external objects, without the presence and the perception of which they could not possibly have arisen. And it should be alike obvious, that the emotions owe their being to a mental perception, whether by sense or by memory, of the objects which are fitted to awaken them. Let an object be introduced to the notice of the mind, and its correlative emotion instantly arises in the heart; let the object be forgotten or disappear from the mental view, and the emotion disappears along with it.

9. We deem it no exception to the invariableness of that relation, which subsists between an object and its counterpart emotion, that, in many instances, a certain given object may be present and in full view of the observer, without awakening that sensibility which is proper to it. A spectacle of pain does generally, but not always, awaken compassion. It would always, we think, if a creature in agony were the single object of the mind's contemplation. But the person, now in suffering, may be undergoing the chastisement of some grievous provocation; and the emotion is different, because the object is really different—an offender who has excited the anger of our bosom, and, in the view of whose inflicted sufferings, this indignant feeling receives its gratification. Or the pain may be inflicted by our own hand on an unoffending animal in the prosecution of some cruel experiment. If compassion be wholly unfelt, it is not because in this instance the law has been repealed which connects this emotion with the view of pain; but it is because the attention of the mind to this object is displaced by another object; even the discovery of truth—and so what but for this might have been an intense compassion, is overborne by an intenser curiosity. And so with all the other emotions. Were danger singly the object of

the mind's contemplation, fear, we think, would be the universal feeling; but it may be danger connected with the sight or the menaces of an insulting enemy who awakens burning resentment in the heart, and when anger rises, fear is gone; or it may be danger shared with fellow-combatants, whose presence and observation kindle in the bosom the love of glory and impel to deeds of heroism—not because any law which connects, and connects invariably, certain emotions with certain objects, is in any instance reversed or suspended; but because, in this conflict and composition of moral forces, one emotion displaced another from the feelings, only, however, because one object displaced another from the thoughts. Still, in every instance, the object is the stepping-stone to the emotion—insomuch, that if we want to recall a certain emotion, we must recall to the mind that certain object which awakens it; if we want to cease from the emotion, we must cease from thinking of its object, we must transfer the mind to other objects, or occupy it with other thoughts.

10. This connexion between the percipient faculties of the mind and its feelings, reveals to us a connexion between the intellectual and the moral departments of our nature. How the one is brought instrumentally to bear upon the other will be afterwards explained. But meanwhile it is abundantly obvious, that the presence or the absence of certain feelings stands connected with the presence or the absence of certain thoughts. We can no more break up the connexion between the thought of any object that is viewed mentally, and the feeling which it impresses on the heart, than we can break up the connexion between the sight of any object that is viewed materially, and the sensation which it impresses upon the retina. If we look singly and steadfastly to an object of a particular colour, as red, there is an organic necessity for the peculiar sensation of redness, from which we cannot escape, but by shutting our eyes, or turning them away to objects that are differently coloured. If we think singly and steadfastly on any object of a particular character, as an injury, there seems an organic necessity also for the peculiar emotion of resentment, from which there appears to be no other way of escaping, than by stifling the thought, or turning the mind away to other objects of contemplation. Now we hear both of virtuous emotions and of vicious emotions; and it is of capital importance to know how to retain the one and to exclude the other—which is by dwelling in thought on the objects that awaken the former, and discharging from thought the objects that awaken the latter. And so it is by thinking in a certain way that wrong sensibilities are avoided, and right sensibilities are upholden. It is by keeping up a remembrance of the kindness, that we keep up the emotion of gratitude. It is by forgetting the provocation, that we cease from the emotion of anger. It is by reflecting on the misery of a fellow-creature in its vivid and affecting details, that

pity is called forth. It is by meditating on the perfections of the Godhead, that we cherish and keep alive our reverence for the highest virtue and our love for the highest goodness. In one word, thought is at once the harbinger and the sustainer of feeling: and this, of itself, forms an important link of communication between the intellectual and moral departments of our nature.

11. We shall not be able to complete our views, either on the moral character of the emotions, or their dependence on the percipient faculties of the mind, until we have established a certain ulterior principle which comes afterwards into notice. Neither do we now expatiate on their uses, of which we have already given sufficient specimens, in our treatment of the special affections. We would only remark at present, on their vast importance to human happiness—seeing that a state of mental happiness cannot even be so much as imagined without a state of emotion. They are the emotions, in fact, and the external affections together, which share between them the whole interest, whether pleasurable or painful, of human existence. And what a vivid and varied interest that is, may be rendered evident, by a mere repetition of those words which compose the nomenclature of our feelings—as hope, and fear, and grief, and joy, and love diversified into so many separate affections towards wealth, fame, power, knowledge, and all the other objects of human desire, besides the tasteful and benevolent emotions—which altogether keep their unremitting play in the heart, and sustain or fill up the continuity of our sensible being. It says enough for the adaptation of external nature to a mental constitution so complexly and variously endowed, that numerous as these susceptibilities are, the world is crowded with objects, that keep them in full and busy occupation. The details of this contemplation are inexhaustible; and we are not sure but that the general lesson of the Divine care or Divine benevolence, which may be founded upon these, could be more effectually learned by a close attention of the mind upon one specific instance, than by a complete enumeration of all the instances, with at the same time only a briefer and slighter notice of each of them.

12. And it would make the lesson all the more impressive, if, instead of selecting as our example, an emotion of very exalted character, and of which the influence on human enjoyment stood forth in bright daylight to the observation of all, such as the sensibility of a heart that was feelingly alive to the calls of benevolence, or feelingly alive to the beauties of nature—we should take for our case some other kind of emotion, so common perhaps as to be ignobly familiar, and on which one would scarcely think of constructing aught so dignified or so serious as a theological argument. Yet we cannot help thinking, that it most emphatically tells us of the teeming, the profuse benevolence of the Deity—when we reflect on those homelier and those every-day sources, out of which, the whole of

human life, through the successive hours of it, is seasoned with enjoyment; and a most agreeable zest is imparted from them, to the ordinary occasions of converse and companionship among men. When the love of novelty finds in the walks of science the gratification that is suited to it, we can reason gravely on the final cause of the emotion, and speak of the purpose of Nature, or rather of the Author of Nature, in having instituted such a reward for intellectual labour. But we lose sight of all the wisdom and all the goodness that are connected with this mental ordination—when the very same principle, which, in the lofty and liberal *savant*, we call the love of novelty, becomes, in the plain and ordinary citizen, the love of news. Yet in this humbler and commonplace form, it is needless to say, how prolific it is of enjoyment—giving an edge as it were to the whole of one's conscious existence, and its principal charm to the innocent and enlivening gossip of every social party. Perhaps a still more effective exemplification may be had in another emotion of this class, that which arises from our sense of the ludicrous—which so often ministers to the gaiety of man's heart, even when alone; and which, when he congregates with his fellows, is ever and anon breaking forth into some humorous conception, that infects alike the fancies of all, and finds vent in one common shout of ecstasy. Like every other emotion, it stands allied with a perception as its antecedent, the object of the perception in this instance being the conjunction of things that are incongruous with each other—on the first discovery or conception of which, the mirth begins to tumultuate in the heart of some one; and on the first utterance of which, it passes with irrepressible sympathy into the hearts of all who are around him—whence it obtains the same ready discharge as before, in a loud and general effervescence. To perceive how inexhaustible the source of this enjoyment is, we have only to think of it in connexion with its cause; and then try to compute, if we can, all the possibilities of wayward deviation, from the sober literalities of truth and nature, whether in the shape of new imaginations by the mind of man, or of new combinations and events in actual history. It is thus that the pleasure connected with our sense of the ludicrous, forms one of the most current gratifications of human life; nor is it essential that there should be any rare peculiarity of mental conformation in order to realize it. We find it the perennial source of a sort of gentle and quiet delectation, even to men of the most sober temperament, and whose habit is as remote as possible from that of fantastic levity, or wild and airy extravagance. When acquaintances meet together in the street, and hold colloquy for a few minutes, they may look grave enough, if business or politics or some matter of serious intelligence be the theme—yet how seldom do they part before some coruscation of playfulness has been struck out between them; and the interview, though begun perhaps in sober earnest, but seldom passes off, without some pleasantry or other to

enliven it. We should not dwell so long on this part of the human constitution, were there not so much of happiness and so much of benevolence allied with it—as is obvious indeed from the very synonymes, to which the language employed for the expression of its various phenomena and feeling has given rise. To what else but to the pleasure we have in the ludicrous is it owing, that a ludicrous observation has been termed a pleasantry; or how but to the affinity between happiness and mirth can we ascribe it, that the two terms are often employed as equivalent to each other; and whence but from the strong connexion which subsists between benevolence and humour can it be explained, that a man is said to be in good humour, when in a state of placidness and cordiality with all who are around him? We are aware that there is not a single disposition wherewith Nature hath endowed us which may not be perverted to evil; but when we see so much both of human kindness and of human enjoyment associated with that exhilaration of heart to which this emotion is so constantly giving rise—ministering with such copiousness, both to the smiles of the domestic hearth, and the gaieties of festive companionship—we cannot but regard it as the provision of an indulgent Father, who hath ordained it as a sweetener or an emollient amid the annoyances and the ills which flesh is heir to.

13. It were difficult to compute the whole effect of this ingredient, in alleviating the vexations of life; but certain it is that the ludicrous is often blended with the annoyances which befall us; and that its operation, in lightening the pressure of what might have otherwise been viewed as somewhat in the light of a calamity, is far from inconsiderable. This balancing of opposite emotions, suggested by different parts of the same complex event or object, and the effect of the one if a pleasant emotion, in assuaging the painfulness of the other, is not an uncommon phenomenon in the exhibitions of human feeling. A very obvious specimen of this is afforded by an acquaintance in the act of falling. There is no doubt an incongruity between the moment of his walking uprightly, and with the full anticipation of getting forward in that attitude to the object whither he is bending—and the next moment of his floundering in the mud, and hastening with all his might to gather himself up again. They who philosophize upon the laws of succession in the events of Nature, have a great demand for such successions as are immediate. They go busily in quest of the contiguous links, and properly conceive that if any one hidden step be yet interposed, between the two which they regularly observe to follow each other, they have not completed the investigation, till that step also have been ascertained. It is therefore so far an advantage in regard to the above phenomenon, that there does not appear to be time even for the most rapid and fugitive intervention—for only let it occur in the presence of lookers on, and, with the speed of lightning, will it be followed

up by the instant and obstreperous glee of a whole host of spectatorship.

14. But this very exhibition may give rise to a wholly different emotion. The provocative to laughter lies in the awkwardness of the fall. Let the awkwardness be conceived to abide as it was, and this other ingredient to be added, the severity of the fall—that a limb is fractured, or that a swoon, a convulsion, or a stream of blood is the immediate consequence. In proportion to the hurt that was sustained, would be the sympathy of far the greater number of the by-standers; and this might be so heightened by the palpable sufferings of him to whom the accident has befallen, that the sense of the ludicrous might be entirely overborne.

15. The two provocatives are the awkwardness of the fall and its severity. The two emotions are the mirth and the compassion. The one of these may so predominate over the other as to leave the mind under its entire and single ascendancy. A mathematician would require the point, at which, by a gradual increase or diminution upon either of the two elements, they were mutually neutralized—or the transition was made from the one to the other of them. In this we may not be able to satisfy him. But all may have been sensible of an occasion, when the two were so delicately poised, that the mind positively vibrated—so as to make a sort of tremulous and intermediate play, between these distinct and nearly opposite emotions. This is one of those nicer exhibitions of our nature that one feels an interest in remarking; and many perhaps may recollect the instances, when even some valued friend hath smarted pretty seriously, under some odd or ludicrous mishap in which he hath been involved, and when they have felt themselves in a state of most curious ambiguity, between the pity which they ought to feel, and the levity which they were not able to repress. The peculiarities of this midway condition are greatly aggravated, if there be so many acquaintances who share it among them, and more especially, if they meet together and talk over the subject of it—in which case, it will be no singular display of our mysterious nature, although the visitations of a common sympathy should be found to alternate with the high-sounding peals of a most rapturous and uncontrollable merriment.

16. We cannot fail to perceive, in this instance too, how inseparable the alliance is between perception and feeling. According as the mind looks, so is the heart affected. When we look to the awkwardness of the mischance, whatever it may be, we become gay. When we look to its severity, we become sad. It is instructive to observe, with what fidelity the heart follows the mind in this process, and how whichever the object is that for the time is regarded by the one, it is sure to be responded to by an appropriate emotion from the other.

17. We should not have ventured on these illustrations, but for

the lesson which they serve to establish. They prove the extent to which a sense of the ludicrous might lighten and divert the painfulness of those serious feelings to which humanity is exposed. It is true that much evil may be done, when it puts to flight, as it often does, seriousness of principle; but, on the other hand, there is unquestionable good done by it, when it puts to flight, either the seriousness of resentment—or the seriousness of suffering. And when we think of its frequent and powerful effect, both in softening the malignant asperities of debate, and in reconciling us to those misadventures and pettier miseries of life, which, if not so alleviated, would keep us in a state of continual festering—we cannot but regard even this humbler part of the constitution of man, as a palpable testimony both to the wisdom and goodness of Him who framed us.*

18. Before quitting this department of the subject, we may advert, not to an individual peculiarity, but to the respective characters by which two classes of intellect are distinguished, and to the effect of their mutual action and reaction on the progress of opinion in the world.

19. The first of these intellectual tendencies may be seen in those who are distinguished by their fond and tenacious adherence to the existing philosophy, and by their indisposition to any changes of it. They feel it painful to relinquish their wonted and established habits of thought—as if the mind were to suffer violence, by having to quit its ancient courses, and to unlearn the opinions of other days. We have no doubt that the love of repose, the aversion of that

* “The advantages which we derive from our susceptibility of this species of emotion, are, in their immediate influence on the cheerfulness, and therefore on the general happiness of society, sufficiently obvious. How many hours would pass wearily along, but for those pleasantries of wit, or of easier and less pretending gaiety which enliven what would have been dull, and throw many bright colours on what would have been gloomy. We are not to estimate these accessions of pleasure lightly, because they relate to objects that may seem trifling, when considered together with those more serious concerns, by which our ambition is occupied, and in relation to which, in the success or failure of our various projects, we look back on the past months or years of our life as fortunate or unfortunate. If these serious concerns alone were to be regarded, we might often have been very unhappy, as in other circumstances we might often have had much happiness in the hours and days of years, which terminated at last in the disappointment of some favourite scheme. It is good to travel with pure and balmy airs, and cheerful sunshine, though we should not find, at the end of our journey, the friend whom we wished to see; and the gaieties of social converse, though they are not, in our journey of life, what we travel to obtain, are during the continuance of our journey at once a freshness which we breathe, and a light that gives every object to sparkle to our eye with a radiance that is not its own.” *Brown's Lectures*—Lecture 59. But this emotion is allied with benevolence as well as with enjoyment. There is perhaps not a more welcome topic at the tables of the great, than the characteristic peculiarities or oddities of humble life—and we have no doubt that along with the amusement which is felt in the cottage anecdotes of a domain, there is often awakened by them, a benevolent interest in the well-being of the occupiers.

mental labour which is requisite even for the understanding of a new system, or at least for the full comprehension and estimate of its proofs—enters largely into this dislike for all novelties of speculation, into this determined preference for the doctrines in which they have been educated—although the associations too of taste and reverence share largely in the result. It is thus that the old are more disinclined to changes; and there is a peculiar reason why schools and corporations of learning should make the sturdiest resistance to them. It is a formidable thing to make head against that majority within the walls of every venerable institute, which each new opinion has to encounter at the outset; and more especially, if it tend to derange the methods of a university, or unsettle the long established practice of its masters. This will explain that inveteracy of long possession, which, operating both in many individual minds and in the bosom of colleges, gives formation and strength to what may be termed the conservative party in science or in the literary commonwealth—that party which maintains the largest and most resolute contest with all new opinions, and will not give way, till overpowered by the weight of demonstration, and energy of the public voice in their favour.

20. Opposed to this array of strength on the side of existing principles, we have the incessant operations of what may be termed the movement party in science or in the literary commonwealth—some of whom are urged onward by the mere love of novelty and change; others by the love of truth; and very many by a sort of ardent and definite imagination of yet unreached heights in philosophy, and of the new triumphs which await the human mind in its interminable progress from one brilliant or commanding discovery to another. We have often thought that a resulting optimism is the actual effect of the play or collision that is constantly kept up between these two rival parties in the world of letters. On the one hand it is well, that philosophy should not be a fixture, but should at length give way, to the accumulating force of evidence. But on the other hand it is well, that it should require a certain, and that a very considerable force of evidence, ere it shall quit its present holds, or resign the position which it now occupies. We had rather that it looked with an air of forbidding authority on the mere likelihoods of speculation than that, lightly set agog by every specious plausibility, it should open its schools to a restless and rapid succession of yet undigested theories. It is possible to hold out too obstinately and too long; but yet it is well, that a certain balance should obtain between the adhesive and the aggressive forces in the world of speculation; and that the general mind of society should have at least enough of the sedative in its composition, to protect it from aught like violent disturbance, or the incursion of any rash adventurer in the field of originality. And for this purpose it is well, that each novelty, kept at bay for a time, and made to undergo a

sufficient probation, should be compelled, thoroughly to substantiate its claims—ere it be permitted to take a place beside the philosophy, which is recognised by all the authorities, and received into all the institutes of the land.

21. And they are the very same principles, which, when rightly blended, operate so beneficially, not in philosophy alone, but in politics. There is no spirit which requires more to be kept in check, than that of the mere wantonness of legislation; and so far from being annoyed by that indisposition to change, which is rather the characteristic of all established authorities, we should regard it in the light of a wholesome counteractive, by which to stay the excesses of wild and wayward innovators. There is a great purpose served in society by that law of nature, in virtue of which it is that great bodies move slowly. It would not answer, if a government were to veer and to vacillate with every breath of speculation—it easily liable to be diverted from the steadfastness of their course, by every lure or by every likelihood which sanguine adventurers held out to them. It is well, that in the ruling corporation, there should be a certain strength of resistance, against which all splendid imaginations and all unsound and hollow plausibilities, might spend their force and be dissipated; and, so far from complaining of it as an impracticable engine which is so hard and difficult of impulse, we should look upon its very unwieldiness in the light of a safeguard, without which we should be driven to and fro by every wind of doctrine on a troubled sea that never rests. On these accounts we feel inclined, that, in the vessel of the body politic, there should be a preponderance of ballast over sail; and that it really is so, we might put to the account of that optimism, which, with certain reservations, obtains to a very great degree, in the framework, and throughout the whole mechanism of human society.

22. But this property in the machine of a government to which we now advert, does not preclude that steady and sober-minded improvement which is all that is desirable. It only restrains the advocates of improvement from driving too rapidly. It does not stop, it only retards their course, by a certain number of defeats and disappointments, which, if their course be indeed a good one, are but the stepping stones to their ultimate triumph. Ere that the victory is gotten, they must run the gauntlet of many reverses and many mortifications; and they are not to expect by one, but by several and successive blows of the catapulta, that inveterate abuses and long established practices can possibly be overthrown. It is thus, in fact, that every weak cause is thrown back into the nonentity whence it sprung, and that every cause of inherent goodness or worth is ultimately carried—rejected, like the former, at its first and earliest overtures; but, unlike the former, coming back every time with a fresh weight of public feeling and public demonstration in its favour, till, like the abolition of the slave trade or that of com-

mercial restrictions, causes which had the arduous struggle of many long years to undergo, it at length obtains the conclusive seal upon it of the highest authority in the land, and a seal by which the merits of the cause are far better authenticated, than if the legislature were apt to fluctuate at the sound of every new and seemly proposal. We have therefore no quarrel with a certain *vis inertiae* in a legislature. Only let it not be an absolute fixture; and there is the hope, with perseverance, of all that is really important or desirable in reformation. The sluggishness that has been ascribed to great corporations is, in the present instance, a good and desirable property—as being the means of separating the chaff from the wheat of all those overtures, that pour in upon representatives from every quarter of the land; and, so far from any feeling of annoyance at the retardation to which the best of them is subjected, it should be most patiently and cheerfully acquiesced in, as being in fact the process, by which it brightens into prosperity, and at length its worth and its excellence are fully manifested.

23. It is not the necessary effect of this peculiar mechanism, it is but the grievous perversion of it, when the corrupt inveteracy has withstood improvement so long, that ere it could be carried, the assailing force had to gather into the momentum of an energy that might afterwards prove mischievous, when the obstacle which provoked it into action had at length been cleared away. It is then that the vessel of the state which might have been borne safely and prosperously onward in the course of ages, by a steady breeze and with a sufficiency of ballast, as if slipped from her moorings is drifted uncontrollably along, and precipitated from change to change with the violence of a hurricane.

CHAPTER III.

On the Connexion between the Intellect and the Will.

1. THERE is distinction made between a mental susceptibility and a mental power. Should we attempt to define it, we might say of the power, that it implies a reference to something consequent and of the susceptibility that it implies a reference to something antecedent. It is thus that a volition is conceived to indicate the former, and an emotion to indicate the latter. Anger would be spoken of rather as a susceptibility of the mind than as a power; and a will rather as a power than as a susceptibility. We view anger in connexion with the provocatives which went before it; and so regarding it as an effect, we conceive of the mind in which this effect has been

wrought, as being at the time in a state of subject passiveness. We view the will in connexion with the deeds which follow on its determinations; and so regarding it as a cause, we conceive of the mind when it wills as being in a state of active efficiency. And yet a determination of the will may be viewed not merely as the prior term to the act which flows from it, but also as the posterior term to the influence which gave it birth—or in other words, either as the forthcoming of a power or as the result of a susceptibility. It is thus that desire, which on looking backward to the cause from whence it sprung, we should call a susceptibility—on looking forward to the effect which it prompts for the attainment of its object, we should call an impellent; and thus depth of feeling is identical, or at least, in immediate contact with decision and intensity of purpose.

2. But in our intènt prosecution of this analysis, and use of those appropriate terms which are employed for expressing the results of it, we have often to desert the common language, and are apt to lose sight of certain great and palpable truths, of which that language is the ordinary vehicle. When tracing the intermediate steps, between the first exposure of the mind to a seducing influence, and the deed or perpetration of enormity into which it is hurried, we are engaged in what may properly be termed a physical inquiry—as much so as, when passing from cause to consequent, we are attending to any succession or train of phenomena in the material world. But it is when thus employed that we are so apt to lose sight of the moral character of that which we are contemplating; and to forget when or at what point of the series it is that the designation whether of virtuous or vicious, the charge whether of merit or demerit, comes to be applicable.* It is well that, amid all the difficulties attendant

* Dr. Brown has well distinguished between the two inquiries in the following sentences. “In one very important respect, however, the inquiries, relating to the physiology of mind, differ from those which relate to the physiology of our animal frame. If we could render ourselves acquainted with the intimate structure of our bodily organs, and all the changes which take place, in the exercise of their various functions, our labour, with respect to them, might be said to terminate. But though our intellectual analysis were perfect, so that we could distinguish, in our most complex thought or emotion, its constituent elements, and trace with exactness the series of simpler thoughts which have progressively given rise to them, other inquiries, equally or still more important, would remain. We do not know all which is to be known of the mind when we know all its phenomena, as we know all which can be known of matter, when we know the appearances which it presents, in every situation in which it is possible to place it, and the manner in which it then acts or is acted upon by other bodies. When we know that man has certain affections and passions, there still remains the great inquiry, as to the propriety or impropriety of these passions, and of the conduct to which they lead. We have to consider, not only how he is capable of acting, but also, whether, acting in the manner supposed, he would be fulfilling a duty or perpetrating a crime. Every enjoyment which man can confer on man, and every evil which he can reciprocally inflict or suffer, thus become objects of two sciences—first of that intellectual analysis which traces the happiness and misery, in their various forms and sequences, as mere phenomena or states of the substance mind;—and secondly, of that ethical judgment, which measures our approbation and disapprobation, esti-

on the physiological inquiry, there should be such a degree of clearness and uniformity in the moral judgments of men—inasmuch that the peasant can, with a just and prompt discernment equal to that of the philosopher, seize on the real moral characteristics of any action submitted to his notice, and pronounce on the merit or demerit of him who has performed it. It is in attending to these popular or rather universal decisions, that we learn those phenomena which are of main importance to our argument—now that, after having bestowed a separate attention on the moral and intellectual constitutions of human nature, we are investigating the connexion which is between them.

3. The first of those popular or rather universal decisions, which we shall at present notice, is, that nothing is moral or immoral which is not voluntary. A murderer may be conceived, instead of striking with the dagger in his own hand, to force it, by an act of refined cruelty, into the hand of him, who is the dearest relative or friend of his devoted victim; and, by his superior strength, to compel the struggling and the reluctant instrument to its grasp. He may thus confine it to the hand, and give impulse to the arm of one, who recoils in utmost horror from that perpetration, of which he has been made as it were the material engine; and could matters be so contrived, as that the real murderer should be invisible, while the arm and the hand that inclosed the weapon, and the movements of the ostensible one, should alone be patent to the eye of the senses—then he and not the other would be held by the by-stander as chargeable with the guilt. But so soon as the real nature of the transaction came to be understood, this imputation would be wholly and instantly transferred. The distinction would at once be recognised between the willing agent in this deed of horror and the unwilling instrument. There would no more of moral blame be attached to the latter, than to the weapon which inflicted the mortal blow; and on the former exclusively, the whole burden of the crime and its condemnation would be laid. And the simple difference which gives rise to the whole of this moral distinction in the estimate between them, is, that with the one the act was with the will; with the other it was against it.

4. The will may be spoken of either as a faculty of the mind, or, it may denote one separate and individual act of willing. He willed to take a walk with me. It was his will so to do. But there is another term which is more properly expressive of the act, and is not at all expressive of the faculty. Those terms which discriminate, and which restrict language to a special meaning, are very conve-

minating, with more than judicial scrutiny, not merely what is done, but what is scarcely thought in secrecy and silence, and discriminating some element of moral good or evil, in all the physical good and evil, which it is in our feeble power to execute, or in our still feebler heart to conceive and desire." *Brown's Lectures*, Lecture 1.

nient both in science and in common life. The will then may express both the faculty and the act of willing. But the act of willing has been further expressed by a term appropriated wholly to itself—and that is, volition. Mr. Locke defines volition to be “an act of the mind, knowingly, exerting that dominion it takes itself to have over any part of the man, by employing it in, or withholding it from any particular action.” And Dr. Reid more briefly, but to the same effect, says that it is—“the determination of the mind to do or not to do something which we conceive to be in our power.” He very properly remarks, however, that, after all, determination is only another word for volition; and he excuses himself, at the same time, from giving any other more logical definition—on the plea, that simple acts of the mind do not admit of one.

5. There is certainly a ground, in the nature and actual workings of the mental constitution, for the distinction, which has been questioned of late, between will and desire. Desire has been thus defined by Locke—“It is the uneasiness man finds in himself, upon the absence of any thing, whose present enjoyment carries the idea of delight with it”—an uneasiness which many may remember to have felt in their younger days, at the sight of an apple of tempting physiognomy, that they would fain have laid hold of, but were restrained from touching by other considerations. The desire is just the liking that one has for the apple; and by its effectual solicitations, it may gain over the will to its side—in which case, through the medium of a volition, the apple is laid hold of, and turned to its natural application. But the will may, and often does, refuse its consent; and we then better perceive the distinction between the desire and the will, when we thus see them in a state of opposition—or when the urgency of the desire is met by other urgencies, which restrain the indulgence of it. One might be conceived, as having the greatest appetency for the fruit, and yet knowing it to be injurious to his health—so that however strong his desires, his will keeps its ground against their solicitations. Or he may wish to reserve it for one of his infant children; and so his will sides with the second desire against the first, and carries this latter one into execution. Or he may reflect, after all, that the apple is not his own property, or that perhaps he could not pull it from among the golden crowds and clusters around it, without injury to the tree upon which it is hanging; and so he is led by the sense of justice to keep both the one and the other desire at obeyance—and the object of temptation remains untouched, just because the will combats the desire instead of complying with it, and refuses to issue that mandate, or in other words, to put forth that volition, which would instantly be followed up by an act and an accomplishment. And thus, however good the tree is for food, and however pleasant to the eyes, and however much to be desired, so as to make one taste and be satisfied—yet, if strong enough in all

these determinations of prudence or principle, he may look on the fruit thereof and not eat.

6. Dr. Brown and others would say, that there is nothing in this process, but the contest of opposite desires and the prevalence of the strongest one—and so identify will and desire with each other.* But though a volition should be the sure result of a desire, that is no more reason why they should be identified, than why the prior term of any series in nature should be identified or confounded, with any of its posterior terms, whether more or less remote. In the process that we have been describing, there were different desires in play, but there were not different volitions in play. There was one volition appended to the strongest desire; but the other desires though felt by the mind, and therefore in actual being, had no volitions appended to them—proving that a desire may exist separately from the volition that is proper to it, and that therefore the two are separate and distinct from each other. The truth is, using Dr. Brown's own language, the mind is in a different state when framing a volition, from what it is when feeling a desire. When feeling a desire, the mind has respect to the object desired—which object, then in view of the mind, is acting with its own peculiar influence on a mental susceptibility. When framing a volition the mind has respect, not properly to the object, but to the act by which it shall attain the object—and so is said to be putting forth a mental power.† But whether this distinction be accurately expressed or not, certain it is, the mind is differently conditioned, when in but a state of simple desire—from what it is when in the act of conceiving a volition. It is engaged with different things, and looking different ways—in the one case to the antecedent object which has excited the desire, in the other case to the posterior act on which the will has determined for the attainment of the object. The palsied man who cannot stretch forth his

* Edwards, at the outset of his treatise on the Will, controverts Locke; but in such a way as reduces the difference between them very much to a question of nomenclature. On the one hand, the difference between a volition and a desire does not affect the main doctrine of Jonathan Edwards; for, though volitions be distinct from desires, they may nevertheless be the strict and unvarying results of them. Even Edwards himself seems to admit, that the mind has a different object in willing from what it has in desiring—an act of our own being the object of the one; the thing desired being the object of the other. It serves to mark more strikingly the distinction between willing and desiring, when even an act of our own is the proper object of each of them. There may be a great desire to inflict a blow on an offender; but this desire, restrained by considerations of prudence or principle, may not pass into a volition. Edwards would say that even here the volition does not run counter to the desire, but only marks the prevalence of the stronger desire over the weaker one. Now this is true; but without at all obliterating the distinction for which we contend. The volition does run counter to the weaker desire, though under the impulse of the stronger, and there are three distinct mental phenomena in this instance, the stronger desire, the weaker desire and the volition, which ought no more to be confounded, than any movement with the motive forces that gave rise to it, or than the posterior with the prior term of any sequence.

† See Art. 1. of this chapter.

hand to the apple that is placed in the distance before him, may, nevertheless, long after it; and in him we perceive desire singly—for he is restrained by very helplessness from putting forth a volition, the proper object of which is some action of our own, and that we know to be in our own power. We accept with great pleasure of that simplification by Dr. Brown, in virtue of which we regard the mind not as a congeries of different faculties, but as, itself one and indivisible, having the capacity of passing into different states; and without conceiving any distinction of faculties, we only affirm that it is in a different state when it wills, from that in which it is when it simply desires. Notwithstanding the high authority both of Dr. Brown and Mr. Mill, we think that in confounding these two, they have fallen into an erroneous simplification; and we abide by the distinction of Dugald Stewart and the older writers upon this subject.*

7. But the point of deepest interest is that step of the process, at which the character of right or wrong comes to be applicable. It is not at that point, when the appetites or affections of our nature solicit from the will a particular movement; neither is it at that point, when either a rational self love or a sense of duty remonstrates against it. It is not at that point when the consent of the

* Hume says very well of desire, that—"It arises from good considered simply and aversion from evil. The will again exerts itself, when either the presence of the good or absence of the evil may be attained by any action of the mind or body." This is the definition of Hume, and it is a very good one. And it tallies with the sensible remark of Dr. Reid, that the object of every volition is some action of our own. And upon this he founds some very clear illustrations of the difference that there is between a desire and a volition. "A man desires that his children may be happy, and that they may behave well. Their being happy is no action at all; and their behaving well is not his action but theirs." "A man athirst has a strong desire to drink; but for some particular reason he determines not to gratify his desire." Here the man has the desire but not the will. In other cases he may have the will but not the desire. "A man for health may take a nauseous drug, for which he has no desire, but a great aversion." Desire, therefore, is not will; but only one of the incitements that often leads to it—though it may at all times be and actually sometimes is withstood. It is, however, because desire is so often accompanied by will, that we are apt to overlook the distinction between them.

I may here observe that to frame a volition is sometimes expressed more shortly by the phrase, to will. I will put forth my hand, is different from, I desire to put it forth. There may be reasons why I should restrain the desire—so that though I desire it, I may not will it. For this application of the verb to will, we have the authority of the best English writers. "Whoever," says Dr. South, "wills the doing of a thing, if the doing of it be in his power, he will certainly do it; and whoever does not do the thing which he has in his power to do, does not properly will it." And Locke says, "the man that sits still is said to be at liberty, because he can walk if he wills it." Dr. South makes a happy discrimination, which serves to throw light upon the precise nature of a volition as opposed to other things that may or may not lead to a volition—when he says, "that there is as much difference between the approbation of the judgment and the actual volition of the will, as between a man's viewing a desirable thing, and reaching after it with his hand." He further says of a wish, which is nought but a longing desire, that—"a wish is properly the desire of a man who is sitting or lying still; but an act of the will is a man of business vigorously going about his work."

will is pleaded for, on the one side or other—but all-important to be borne in mind, it is at that point when the consent is given. When we characterise a court at law for some one of its deeds—it is not upon the urgency of the argument on one side of the question, or of the reply upon the other, that we found our estimate; but wholly upon the decision of the bench, which decision is carried into effect by a certain order given out to the officers who execute it. And so, in characterising an individual for some one of his doings, we found our estimate, not upon the desires of appetite that may have instigated him on the one hand, or upon the dictates of conscience that may have withstood these upon the other—not upon the elements that conflicted in the struggle, but on the determination that put an end to it—even that determination of the will, which is carried into effect by those volitions, on the issuing of which, the hands, and the feet, and the other instruments of action are put into instant subserviency.

8. To prove how essentially linked together, the morality of any act is with its wilfulness, it is of no consequence, whether the volition that gave rise to the act, be the one which preceded it immediately as its proximate cause, or be a remote and anterior volition—in which latter case, it is termed a purpose, conceived at some period which may have long gone by, but which was kept unalterable till the opportunity for its execution came round.* There may be an interval of time, between that resolution of the will which is effective, and that performance by which it is carried into effect. One may resolve to-day, with full consent and purpose of the will, on some criminal enterprise for to-morrow. It is to-day that he has become the criminal, and has incurred a guilt to which even the performance of the morrow may bring no addition and no enhancement. The performance of to-morrow does not constitute the guilt, but only indicates it. It may prove what before the execution of the will was still an uncertainty. It may prove the strength of that determination which has been already taken—how it can stand its ground through all the hours which intervene between the desire and its fulfilment; how meanwhile the visitations of reflection and remorse have been kept at a distance, or all been disregarded; how with relentless depravity, the purpose has been adhered to, and the remonstrances of conscience or perhaps the entreaties of virtuous friendship have all been set at nought; how, with a hardihood that could brave alike the disgrace and the condemnation which attach to moral worthlessness, he could proceed with unflinching step from the reprobate design to its full and final accomplishment—nor suffer all the suggestions of his leisure and

* It is true that if the desire were to cease for the object to be attained by the proposed act, the purpose would cease along with it, but it were confounding the things which in reality are distinct from each other, to represent on this account the desire and the purpose as synonymous. The one respects the object that is wished for; the other respects the action, by which the object is to be attained.

solitude, however affecting the thought of that innocence which he is now on the eve of forfeiting, or a tenderness for those relatives who are to be deeply wounded by the tidings of his fall, or the authority of a father's parting advice, or the remembrance of a mother's prayers, to stay his hand.

9. That an action then be the rightful object, either of moral censure, or approval, it must have had the consent of the will to go along with it. It must be the fruit of a volition—else it is utterly beyond the scope, either of praise for its virtuousness or of blame for its criminality. If an action be involuntary, it is as unfit a subject for any moral reckoning, as are the pulsations of the wrist. Something ludicrous might occur, which all of a sudden sets one irresistibly on the action of laughing; or a tale of distress might be told, which, whether he wills or not, forces from him the tears of sympathy, and sets him as irresistibly on the action of weeping; or, on the appearance of a ferocious animal, he might struggle with all his power for a serene and manly firmness, yet struggle in vain against the action of trembling; or if instead of a formidable a loathsome animal was presented to his notice, he might no more help the action of a violent recoil perhaps antipathy against it, than he can help any of the organic necessities of that constitution which has been given to him; or even upon the observation of what is disgusting in the habit or countenance of a fellow man, he may be overpowered into a sudden and sensitive aversion; and lastly, should some gross and grievous transgression against the decencies of civilized life be practised before him, he might no more be able to stop that rush of blood to the complexion which marks the inward workings of an outraged and offended delicacy, than he is able to alter or suspend the law of its circulation. In each of these cases the action is involuntary; and precisely because it is so, the epithet neither of morally good nor of morally evil can be applied to it. And so of every action that comes thus to speak of its own accord; and not at the will or bidding of the agent. It may be painful to himself. It may also be painful to others. But if it have not had the consent of his will, even that consent without which no action that is done can be called voluntary, it is his misfortune and not his choice; and though not indifferent in regard to its consequences on the happiness of man, yet, merely because disjoined from the will, it in point of moral estimation is an act of the purest indifference.

10. How then, it may be asked, can any moral character be affixed to an emotion, which seems to be an organic or pathological phenomenon, wherewith the will may have little, perhaps nothing to do. Nothing we have affirmed is either virtuous or vicious, unless the voluntary in some way intermingles with it; and how then shall we vindicate the moral rank which is commonly assigned to the mere susceptibilities of our nature? We regard compassion as a virtuous sensibility; and we regard malignity, or licentiousness, or

envy, as so many depraved affections; and yet, on our principle, they are virtuous or vicious, only in so far as they are wilful. It is clearly at the bidding of his will, that a man acts with his hand, and therefore we are at no loss to hold him responsible for his doings; but we must learn how it is at the bidding of his will that he feels with his heart, ere we can hold him responsible for his desires. If apart from the will, there be neither moral worth nor moral worthlessness—if it be implied in the very notion of desert that the will has had some concern in that which we thus characterise—if neither actions nor affections are, without volitions, susceptible of any moral reckoning—it may require some consideration to perceive, how far the element of moral worth is at all implicated in an emotion. If the emotions of sympathy be as much the result of an organic framework as the emotions of taste, and if this be true of all the emotions—it remains to be seen, why either praise or censure should be awarded to any of them. Whether an emotion of taste arises within me at the sight of beauty, or an emotion of pity at the sight of distress—the mind may have been as passive, or there may have been as much of the strictly pathological in the one emotion as in the other.

11. Now it may be very true, that the will has as little to do with that pathological law, by which the sight of distress awakens in my bosom an emotion of pity, as with that other pathological law by which the sight of a red object impresses on my retina the sensation peculiar to that colour. Yet the will, though not the proximate, may have been the remote and so the real cause, both of the emotion and sensation notwithstanding. It may have been at the bidding of my will, that, instead of hiding myself, from my own flesh, I visited a scene of wretchedness, and entered within the confines as it were of that pathological influence, in virtue of which, after that the spectacle of suffering was seen the compassion was unavoidable. And it is also at the bidding of my will, that I place myself within view of an object of sense; that I direct my eye towards it, and keep it open to that sensation, which, after the circumstances that I have voluntarily realized, is equally unavoidable. I might have escaped from the emotion, had I so willed, by keeping aloof from the spectacle which awakened it. And I might escape from the sensation, if I so will, by shutting my eyes, or turning them away from the object which is its cause; or, in other words, by the command which I have over the looking faculty that belongs to me. And perhaps the mind has a looking faculty, as well as the body, in virtue of which, as by the one objects are either removed from, or made present to the sight, so by the other, objects may be either removed from, or made present to the thoughts. Could we ascertain the existence and operations of such a faculty, this would explain how it is, that the emotions are subordinated not immediately but mediately to the will—that the mind by the direction of its looking faculty towards the counterpart objects, could, on the one hand,

will these emotions into being ; or by the direction of it away from these objects, could, on the other hand, will them again into extinction. Such we hold to be the faculty of *attention*. It forms the great link between the intellectual and moral departments of our nature ; or between the percipient and what has already been named the pathematic departments. It is the control which the will has over this faculty that makes man responsible for the objects which he chooses to entertain, and so responsible for the emotions which pathologically result from them.

12. If it be by a voluntary act that he comes to see certain objects, then, whatever the emotions are which are awakened by these objects, he may be said to have willed them into being. In like manner, if it be by a voluntary act that he comes to think of certain objects, then, may it also be said, that he wills all the emotions which follow in their train. It is admitted on all hands, that, by the power which the will has over the muscles of the human frame, it can either summon into presence or bid away certain objects of sight. And, notwithstanding the effect which the expositions of certain metaphysical reasoners have had, in obscuring the process, it is also admitted, almost universally, that, by the power which the will has over the thinking processes, it can either summon into presence or bid away certain objects of thought. The faculty of attention we regard as the great instrument for the achievement of this—the ligament which binds the one department of our constitution to the other—the messenger, to whose wakefulness and activity we owe all those influences, which pass and repass in constant succession between our moral and intellectual nature.

13. Dr. Reid, in his book on the active powers, has a most important chapter on those operations of the mind that are called voluntary. Among these, he gives a foremost place to attention—where, instead however of any profound or careful analysis, he presents us with a number of very sensible remarks ; and from the undoubted part which the will has in the guidance and exercise of this faculty, he comes to the sound conclusion, that a great part of wisdom and virtue consists in giving the proper direction to it.

14. Dugald Stewart ranks attention among the intellectual faculties ;—and seems to regard it as an original power, which had very much escaped the notice of former observers. But Dr. Brown we hold to have been far the most successful in his expositions of this faculty ; and by which he makes it evident, that it is not more distinct from the mental perception of any object of thought, than the faculty of looking to any object of sight, is distinct from the faculty of seeing it.

15. In his chapter on the external affections combined with desire, he institutes a beautiful analysis ; in the conduct of which, he has thrown the magic tints of poetry over a process of very abstract but conclusive reasoning. We fear, that, in this age of superficial readers,

the public are far from being adequately aware of that wondrous combination of talent, which this singularly gifted individual realized in his own person; and with what facility, yet elegance, he could intersperse the graces of fancy, among the demonstrations of a most profound and original metaphysics. The passage to which we now refer, is perhaps the finest exemplification of this in all his volumes; and though we can hardly hope, that the majority, even of the well educated, will ever be tempted to embark on his adventurous speculations—yet many, we doubt not, have been led by the fascination of his minor accomplishments, to brave the depths and the difficulties of that masterly course which he has given to the world. For among the steeps and the arduous elevations of that high walk which he has taken, he kindly provides the reader with many a resting place—some enchanted spot, over which the hand of taste hath thrown her choicest decorations; or where, after the fatigues and the triumphs of successful intellect, the traveller may from the eminence that he has won, look abroad on some sweet or noble perspective, which the great master whose footsteps he follows hath thrown open to his gaze. It is thus that there is a constant relief and refreshment afforded along that ascending way, which but for this would be most severely intellectual; and if never was philosophy more abstruse, yet never was it seasoned so exquisitely, or spread over a page so rich in all those attic delicacies of the imagination and the style which could make the study of it attractive.

16. There is a philosophy not more solid or more sublime of achievement than his, but of sterner frame—that would spurn “the fairy dreams of sacred fountains and elysian groves and vales of bliss.” For these he ever had most benignant toleration, and himself sported among the creations of poetic genius. We are aware of nought more fascinating, than the kindness and complacency, wherewith philosophy, in some of the finer spirits of our race, can make her graceful descent into an humbler but lovelier region than her own—when “the intellectual power bends from his awful throne a willing ear and smiles.”

17. “If,” says Dr. Brown, “Nature has given us the power of seeing many objects at once, she has given us also the faculty of looking but to one—that is to say of directing our eyes on one only of the multitude;” and again, “there are some objects which are more striking than others, and which of themselves almost call us to look at them. They are the predominant objects around which others seem to arrange themselves.”

18. The difference between seeing a thing and looking at it, is tantamount to the difference which there is, between the mere presence of a thought in one's mind and the mind's attention to that which is the object of thought. Now the look, according to Dr. Brown's analysis, is made up of the simple external affection of sight, and a desire to know more about some one of the things which we

do see. We think it the natural consequence of the error into which he has fallen, of confounding the desire with the will, that he has failed in giving a complete or continuous enough description of the process of attention—for, without any violence to the order of his own very peculiar contemplations, he might have gone on to say, as the effect of this mixed perception and desire on the part of the observer, that he willed to look to the object in question; and he might have spoken of the volition which fastened his eye and his attention upon it. Both he and Mr. Mill seem averse to the intervention of the will in this exercise at all—the one finding room only for desire; and the other for his processes of association, ascribing attention to the mere occurrence of interesting sensations or ideas in the train. Now if this question is to be decided by observation at all, or by consciousness which is the faculty of internal observation, the mental states of desiring and willing seem just as distinguishable as any other mental states whatever. At the time when the mind desires, it bears a respect towards the desirable object; at the time when it wills, it bears a respect towards something different from this, to that act of its own which is put forth for the purpose of attaining the object. The desire that is felt towards the object is specifically a distinct thing, from the volition which prompts or precedes the action. The desire may have caused the volition; but this is no reason why it should be confounded with the volition. And in like manner, a feeling of interest in an idea, or rather in the object of an idea, is quite distinguishable from that volition which respects a something different from this object—which respects an act or exercise of the mind, even the attention that we shall give to it. The interest that is felt in any object of thought may have been the cause, and the sole cause of the attention which we give to it. But the necessary connexion which obtains between the parts of a process, is no reason why we should overlook any part, or confound the different parts with each other. In this instance, Mr. Hume seems to have observed more accurately than either of the philosophers whom we have now named, when he discriminates between the will and the desire, and tells us of the former, that it exerts itself when the thing desired is to be attained by any action of the *mind* or body. A volition is as distinctly felt in the mental as in the bodily process—although it be in the latter only, that the will first acts on some one of the muscles as its instrument, and issues in a visible movement as its required service. The power of the will over an intellectual process is marked by the difference, the palpable difference which there is, between a regulated train of thought and a passive reverie. And there is nothing in the intervention of the will to contravene, or even to modify the general laws of association. Neither does the wish to recover a particular idea, involve in it the incongruity of that idea being both present with and absent from the mind at the same time. We may not have an idea that is absent, and yet have the knowledge of its

being related to some other idea that is present ; and we therefore attend to this latter idea and dwell upon it, for the purpose, as is well expressed by Mr. Mill, of—"giving it the opportunity of exciting all the ideas with which it is associated ; for by not attending to it, we deprive it more or less of that opportunity." It is therefore, as he elsewhere expresses it, that we detain certain ideas and suffer others to pass. But there is nothing inconsistent with the laws or phenomena of association, in our saying of this act of detention that it is a voluntary act—that we detain certain ideas, because we will to detain them.*

19. It is this which *virtuefies* emotion, even though there be nothing virtuous which is not voluntary. It is true that once the idea of an object is in the mind, its counterpart emotion may, by an organic or pathological law, have come unbidden into the heart. The emotion may have come unbidden ; but the idea may not have come unbidden. By an act of the will, it may, in the way now explained, have been summoned at the first into the mind's presence ; and at all events it is by a continuous act of the will that it is detained and dwelt upon. The will is not in contact with the emotion, but it is in contact with the idea of that object which awakens the emotion—and therefore, although not in contact with the emotion, it may be vested with an effectual control over it. It cannot bid compassion into the bosom, apart from the object which awakens it ; but it can bid a personal entry into the house of mourning, and then the compassion will flow apace ; or it can bid a mental conception of the bereaved and afflicted family there, and then the sensibility will equally arise, whether a suffering be seen or a suffering be thought of. In like manner, it cannot bid in the breast the naked unaccompanied feeling of gratitude ; but it can call to recollection, and keep in recollection the kindness which prompts it—and the emotion follows in faithful attendance on its counterpart object. It is thus that we can will the right emotions into being, not immediately but mediately—as the love of God, by thinking on God—a sentiment of friendship, by dwelling in contemplation on the congenial qualities of our friend—the admiration of moral excellence, by means of a serious and steadfast attention to it. It is thus too that we bid away the wrong emotions, not separately and in disjunction from their objects, for the pathological law which unites objects with emotion we cannot break asunder. But we rid our heart of the emotions, by ridding our mind of their exciting and originating thoughts ; of anger, for example, by forgetting the injury ; or of a licentious instigation, by dismissing from our fancy the licentious image, or turning our sight and our eyes from viewing vanity. It is this command of the will over the attention, which, transmuting the intellectual into the moral, makes duties of heedfulness and consideration—and duties too of prime importance, because

* See the Chapter on the Will in Mill's analysis of the human mind.

of the place which attention occupies in the mental system, as the great ligament between the percipient and pathematic parts of our nature. It is by its means that the will is made to touch at least the springs of emotion—if it do not touch the emotions themselves. The will tells on the sensibilities, through an intermediate machinery which has been placed at its disposal; and thus it is, that the culture or regulation of the heart is mainly dependent on the regulation of the thoughts.

20. We may thus be enabled to explain, and perhaps more clearly than before, the force and inveteracy of habit; and that, not by the power of emotions to suggest emotions, but purely by the power of thoughts to suggest thoughts. In this process, the motions will of course intermingle with their own counterpart thoughts; and both ideas and feelings will succeed each other in their customary trains all the more surely, the oftener it has been suffered to pass unbroken by any intervention of the will, any remonstrance from the voice of conscience. It is in this way that the wretched voluptuary, becomes every year the more helpless victim of his own depraved inclinations—because more and more lorded over by those foul imaginations, which are lighted up to him, from almost every object he sees or thinks of; and which now he scarcely has the power, because he never had the honest or sustained will to bid away. That may truly be called a moral chastisement under which he suffers. The more he has sinned, the more helpless is the necessity under which he lies of sinning—a bondage strengthened by every act of indulgence, till he may become the irrecoverable slave of those passions which war against the principles of a better and higher nature. And he is domineered over by passions, because domineered over by thoughts; and it is only by the force of mastery of counteracting thoughts, that the spell is broken—or, in other words, it is through an intellectual medium, that the moral distemper is cleared away. If he be rescued from his delusions to sobriety and virtue, ideas will be the stepping-stones of his returning path—the sirens that will recall him to himself, by chasing away the fascinations wherewith he is encompassed. Could the percipient part of his nature be set right, the pathological part would become whole. He would yet behave himself aright, did he only bethink himself aright; and noble recoveries have been effected, even from most deep and hopeless infatuation, simply by the power of thoughts—when made to dwell on the distress of friends, the poverty and despair of children, the ruin of health as well as fortune, the displeasure of an angry God, the horrors of an unprovided death-bed or an undone eternity.*

* A strict confinement to our assigned objects has hitherto prevented any allusion to Christianity, from which indeed we purposely abstain, till we approach more nearly towards the conclusion of this essay. Still we may here remark how strikingly accordant the philosophy of our nature is with the lessons of the Gospel in regard to the reciprocal acting of its moral and intellectual parts on each other—

21. Actions are voluntary in themselves, in that the mind can will them directly into being. Emotions, though not voluntary in themselves, are so far voluntary in their proximate or immediate causes—in that the mind, to a certain extent, and by the control which it has over the faculty of attention, can will those ideas into its presence by which its emotions are awakened. It is well that a man is thus vested, not only with a control over his actions; but also in a great degree with a control over his emotions, these powerful impellers to action—and it required an exquisite fitting of the intellectual to the moral in man's mental system, ere such a mechanism could be framed. But we not only behold in the relation between the will and the emotions, a skilful adaptation in the parts of the human constitution to each other; we also behold a general and manifold adaptation to this peculiarity in the various objects of external nature. Man can, by means of these objects, either kindle the right emotions in his bosom, or make his escape from those emotions that trouble and annoy him. By an entry into an abode of destitution, he can effectually soften his heart; by an entry into an abode of still deeper suffering, where are to be found the dead or the dying, he can effectually solemnize it. But a still more palpable use of that indefinite number of objects wherewith the world is so filled and variegated, is, that by creating an incessant diversion of the thoughts from such objects as are of malignant influence, it may rid the inner man of the grief, or the anger, or the wayward licentiousness of feeling, which might otherwise have lorded over him; and to the urgent calls of business or duty or amusement, do we owe such lengthened periods of exemption both from the emotions that pain, and from the emotions that would vitiate and deprave us.

22. But there is another application, of at least as high importance, to which this peculiarity of our mental structure is subservient. By the command which the will has over the attention, we become responsible, not only for our states of emotion, but also in a great degree for our intellectual states. The imagination that there is neither moral worth nor moral delinquency in the state of a man's belief, proceeds on the voluntary having had no share in the process which leads to it. Now through the intermedium of the very same faculty, the faculty of attention, the will stands related to the ultimate convictions of the understanding, precisely as it stands related to the ultimate emotions of the heart. It is true that as the object in view of the mind is, so the motion is.—And it is as true that as the evidence in view of the mind is, so the belief is. In neither case

and that not merely in what Scripture enjoins on the management of temptations; but in its frequent affirmation, as a general and reigning principle of the power which its objective doctrines have in transforming the subjective mind which receives them—exemplified in such phrases, as “being sanctified by the truth,” and “keeping our hearts in the love of God, by building ourselves up on our most holy faith.”

has the will to do with the concluding sequence; but in both cases it has equally to do with the sequences that went before it. There may be a pathological necessity beyond our control, in that final step of the succession, which connects the object that is perceived with its counterpart emotion, or the evidence that is perceived with its counterpart belief. But in like manner as it is by the attention, which we might or might not have exercised, that the object is perceived by us, so is it by the attention, which we might or might not have exercised, that the evidence is perceived by us. It is thus that on innumerable questions, and these of vital importance, both to the present well-being and the future prospects of humanity, the moral may have had casual antecedency over the intellectual; and the state of a man's creed may depend on the prior state of his character. We have already seen how a present compassion may have been the result of a previous choice; and so may a present conviction be the result of a previous choice—being in proportion not to the evidence possessed by the subject, but to the evidence attended to, and perceived in consequence of that attention. The designations of virtuous and vicious are only applicable to that which is voluntary; and it is precisely because, through the faculty of attention, the voluntary has had so much to do, if not immediately with the belief, at least with the investigations which lead to it—that man may be reckoned with for the judgments of his understanding, as well as for the emotions of his heart or the actions of his history.

23. That man is not rightfully the subject of any moral reckoning for his belief, would appear then, to be as monstrous a heresy in science as it is in theology, as philosophically unsound as it is religiously unsound; and deriving all its plausibility from the imagination, that the belief is in no way dependent upon the will. It is not morally incumbent upon man to see an object, which is placed beyond the sphere of his vision—nor can either a rightful condemnation or a rightful vengeance be laid upon him, because he has not perceived it. It must lie within that sphere, else he is no more responsible for not having reached it with his eye than for not having stretched forth his hand to any of the distant bodies in the firmament. It must be within range of his seeing; and then the only question which needs to be resolved is, what the will has to do with the seeing of it. Now to see is not properly an act of the will, but to look is altogether so; and it is the dependence of his looking faculty on the will, which makes man responsible for what he sees or what he does not see, in reference to all those objects of sight, that are placed within the territory of sensible vision. And if there be but a looking faculty in the mind, man may be alike responsible for what he believes or what he does not believe, in reference, not to sensible objects alone, but to those truths which are placed within the territory of his intellectual or mental vision. Now attention is even such a faculty. Man can turn and transfer it at pleasure from one to another topic

of contemplation. He can take cognisance of any visible thing, in virtue of the power which he has over the eye of his body—a power not to alter the laws of vision, but to bring the organ of vision within the operation of these laws. And he can take cognisance of any announced truth, in virtue of the power he has over his attention which is his mental eye—a power, not to alter the laws of evidence, but to bring the organ of the intellect within their operation. Attention is the looking organ of the mind—the link of communication between man's moral and man's intellectual nature—the messenger, as it were, by which the interchange between these two departments is carried on—a messenger too at the bidding of the will, which saith to it at one time go and it goeth, at another come and it cometh, and at a third do this and it doeth it. It is thus that man becomes directly responsible for the conclusions of his understanding—for these conclusions depend altogether, not on the evidence which exists but on that portion of the evidence which is attended to. He is not to be reckoned with, either for the lack or the sufficiency of the existent evidence; but he might most justly be reckoned with, for the lack or the sufficiency of his attention. It is not for him to create the light of day; but it is for him both to open and to present his eye to all its manifestations. Neither is it for him to fetch down to earth the light of the upper sanctuary. But if it be indeed true that that light hath come into the world, then it is for him to guide the eye of his understanding towards it. There is a voluntary part for him to perform; and thenceforward the question is involved with most obvious moralities. The thing is now submitted to his choice. He may have the light if he only love the light; and if he do not, then are his love of darkness and the evil of his doing, the unquestionable grounds of his most clear and emphatic condemnation.

24. And this principle is of force, throughout all the stages in the process of the inquiry—from the very first glance of that which is the subject of it, to the full and finished conviction in which the inquiry terminates. At the commencement of the process, we may see nothing but the likelihoods of a subject—not the conclusive proofs, but only as yet the dim and dawning probabilities of the question—nothing which is imperative upon our belief, and yet everything which is imperative upon our attention. There may be as great a moral perversity in resisting that call, which the mere semblance of truth makes upon our further attention—as in resisting that call, which the broad and perfect manifestation of it makes upon our conviction. In the practice of Scottish law, there is a distinction made between the precognition and the proof—carried into effect in England by the respective functions of the grand and petty jury; it being the office of the former to find a true bill, or to decide whether the matter in question should be brought to a further trial; and it being the office of the latter to make that trial, and to pronounce the final verdict thereupon. Now what we affirm is,

that there might be to the full as grievous a delinquency in the former act of judgment as in the latter; in the denial of a further hearing to the cause after the strong probabilities which have transpired at the one stage, as in the denial of a fair verdict after the strong and satisfactory proofs which have transpired at the other. All the equities of rectitude may be as much traversed or violated, at the initial or progressive steps of such an inquiry, as by the ultimate judgment which forms the termination of it. To resist a good and valid precognition, and so to refuse the trial, is a moral unfairness of the very same kind, with that resistance of a good and valid proof which leads to the utterance of a false verdict. He were an iniquitous judge, who should internally stifle the impression of those verities, which now brightened forth upon him, at the close of his investigation. But he also were an iniquitous judge, who should stifle the impression of those verisimilitudes, that even but obscurely and languidly beamed upon him at the outset.

25. Now, in all the processes of the human intellect, there is a similar gradation silently yet substantially carried forward. There is first an aspect of probability, which constitutes no claim upon our immediate belief, but which at least constitutes a most rightful claim upon our attention, a faculty, as we before said, at the bidding of our will, and for the exercise of which we are therefore responsible—seeing that whenever there is a rightful claim upon our attention, and the attention is not given, it is wrongously withheld. But we know that the effect of this faculty, is to brighten every object of contemplation to which it is directed, gradually to evolve into greater clearness all its lineaments, and lastly to impress the right conviction upon the understanding. In other words, the man, on such an occasion as this, is intellectually right, but just because he is morally right. He becomes sound in faith; but only in virtue of having become sound in principle. The true belief in which he ultimately lands, is not all at once forced upon him, by the credentials wherewith it was associated; but he had the patience and the candour to wait the unrolling of these credentials; or rather he helped to unroll them with his own hand. He fastened his regards upon some proposition which involved in it the interests or the obligations of humanity; because there sat upon it, even at the first, a certain creditable aspect, which had he had the hardihood to withstand or to turn from, it would have made him chargeable, not with a mental alone, but with a moral perversity—not with the error that springs from a mistaken judgment, but with the guilt that springs from the violation of an incumbent duty. Many are the truths which do not carry an instant and overpowering evidence along with them; and which therefore, at their first announcement, are not entitled to demand admittance for themselves as the articles of a creed. Nevertheless they may be entitled to a hearing; and, by the refusal of that hearing, man incurs, not the misfortune of an involuntary blunder, but the turpitude of a voluntary crime.

CHAPTER IV.

On the Defects and the Uses of Natural Theology.

1. WE behold in the influence which the will has over the intellectual states, the same adaptations which we did in the influence of the will over the emotions. In the first place, it is well that the will should have a certain overruling power over the conclusions of the understanding—seeing that if emotions supply the great impellent forces; doctrines, or the truths which are believed, supply the great principles of action. And secondly, there is a striking adaptation, in this part of our constitution, to the things and the objects which be around us. For although there be much of truth, having that sort of immediate and resistless evidence, which forces itself upon our convictions whether we will or not—there is also much, and that too practically the most momentous, of which we can only attain the conviction and the knowledge, by a lengthened, often a laborious process of inquiry. In like manner as of material objects, they may be seen but imperfectly at the first; and we become fully and minutely acquainted with their visible properties, only by a prolonged look, which is a sustained and voluntary act—so, many are the objects of thought, both the reality and the nature of which, are but dimly apprehended on the first suggestion of them; and of which, we can only be made firmly to believe and thoroughly to know, by means of a prolonged attention, which is a sustained and voluntary act also. It is thus that the moral state determines the intellectual—for it is by the exercise of a strong and continuous will, upholding or perpetuating the attention, that what at the outset were the probabilities of a subject are at length brightened into its proofs, and the verisimilitudes of our regardful notice become the verities of our confirmed faith.

2. Of all the subjects to which the attention of the human mind can be directed, this principle admits of pre-eminent application to the subject of theology—as involving in it, both the present duties and the final destinies of our race. In no other track of inquiry, are the moral and the intellectual more thoroughly blended,—as might be evinced by tracing the whole progress, from the first or incipient disposition of mind towards the theme, to the devotedness of its confirmed assurance.

3. Going back then to the very earliest of our mental conceptions on this subject, we advert first to the distinction in point of real and logical import, between unbelief and disbelief. The former we apprehend, to be the furthest amount of the atheistical verdict on the question of a God. The atheist does not labour to demonstrate that

there is no God. But he labours to demonstrate that there is no adequate proof of there being one. He does not positively affirm the position, that God is not; but he affirms the lack of evidence for the position, that God is. His verdict on the doctrine of a God is only that it is not proven. It is not that it is disproven. He is but an Atheist. He is not an Antitheist.

4. Now there is one consideration, which affords the inquirer a singularly clear and commanding position, at the outset of this great question. It is this. We cannot, without a glaring contravention to all the principles of the experimental philosophy, recede to a further distance from the doctrine of a God, than to the position of simple atheism. We do not need to take our departure from any point further back than this, in the region of antitheism; for that region cannot possibly be entered by us but by an act of tremendous presumption, which it were premature to denounce as impious, but which we have the authority of all modern science for denouncing as unphilosophical. To make this palpable, we have only to contrast the two intellectual states, not of theism and atheism, but of theism and antitheism—along with the two processes, by which alone, we can be logically and legitimately led to them.

5. To be able to say then that there is a God, we have only to look abroad on some definite territory, and point to the vestiges that are given of His power and His presence somewhere. To be able to say that there is no God, we must walk the whole expanse of infinity, and ascertain by observation, that such vestiges are to be found nowhere. Grant that no trace of Him can be discerned in that quarter of contemplation, which our puny optics have explored—does it follow, that, throughout all immensity, a Being with the essence and sovereignty of a God is nowhere to be found? Because through our loopholes of communication with that small portion of external nature which is before us, we have not seen or ascertained a God—must we therefore conclude of every unknown and untrod-den vastness in this illimitable universe, that no diversity is there. Or because, through the brief successions of our little day, these heavens have not once broken silence, is it therefore for us to speak to all the periods of that eternity which is behind us; and to say, that never hath a God come forth with the unequivocal tokens of His existence? Ere we can say that there is a God—we must have seen, on that portion of Nature to which we have access, the print of His footsteps, or have had direct intimation from Himself; or been satisfied by the authentic memorials of His converse with our species in other days. But ere we can say that there is no God—we must have roamed over all nature, and seen that no mark of a Divine footstep was there; and we must have gotten intimacy with every existent spirit in the universe, and learned from each, that never did a revelation of the Deity visit him; and we must have searched, not into the records of one solitary planet, but into the

archives of all worlds, and thence gathered, that, throughout the wide realms of immensity, not one exhibition of a reigning and living God ever has been made. Atheism might plead a lack of evidence within its own field of observation. But antitheism pronounces both upon the things which are, and the things which are not within that field. It breaks forth and beyond all those limits, that have been prescribed to man's excursive spirit, by the sound philosophy of experience; and by a presumption the most tremendous, even the usurpation of all space and of all time, it affirms that there is no God. To make this out, we should need to travel abroad over the surrounding universe till we had exhausted it, and to search backward through all the hidden recesses of eternity; to traverse in every direction the plains of infinitude, and sweep the outskirts of that space which is itself interminable; and then bring back to this little world of ours, the report of a universal blank, wherein we had not met with one manifestation or one movement of a presiding God. For man not to know of a God, he has only to sink beneath the level of our common nature. But to deny him, he must be a God himself. He must arrogate the ubiquity and omniscience of the Godhead.*

6. It affords a firm outset to this investigation, that we cannot recede a greater way from the doctrine to be investigated, than to the simple point of ignorance or unbelief. We cannot, without making inroad on the soundest principles of evidence, move one step back from this, to the region of disbelief. We can figure an inquirer taking up his position in midway atheism. But he cannot, without defiance to the whole principle and philosophy of evidence, make aggression thence on the side of antitheism. There is a clear intellectual principle, which forbids his proceeding in that direction; and there is another principle equally clear, though not an intellectual but a moral one, which urges him, if not to move, at least to look in the opposite direction. We are not asking him, situated

* This idea has been powerfully rendered by Foster in the following passage extracted from one of his essays.—

“The wonder turns on the great process, by which a man could grow to the immense intelligence that can know there is no God. What ages and what lights are requisite for this attainment? This intelligence involves the very attributes of Divinity, while a God is denied. For unless this man is omnipresent, unless he is at this moment in very place in the Universe, he cannot know but there may be in some place manifestations of a Deity by which even *he* would be overpowered. If he does not absolutely know every agent in the Universe, the one that he does not know may be God. If he is not himself the chief agent in the Universe, and does not know what is so, that which is so may be God. If he is not in absolute possession of all the propositions that constitute universal truth, the one which he wants may be that there is a God. If he cannot with certainty assign the cause of all that he perceives to exist, that cause may be a God. If he does not know every thing that has been done in the immeasurable ages that are past, some things may have been done by a God. Thus unless he knows all things, that is, precludes another Deity by being one himself, he cannot know that the Being whose existence he rejects, does not exist.

where he is, to believe in God. For the time being, we as little expect a friendly as we desire a hostile decision upon the question. Our only demand for the present is, that he shall entertain the question. And to enforce the demand, we think that an effective appeal might be made to his own moral nature. We suppose him still to be an atheist, but no more than an atheist—for, in all right Baconian logic, the very farthest remove from theism, at which he or any man can be placed by the lack of evidence for a God, is at the point of simple neutrality. We might well assume this point, as the utmost possible extreme of alienation from the doctrine of a Creator, to which the mind of a creature can in any circumstances be legitimately carried. We cannot move from it, in the direction towards antitheism, without violence to all that is just in philosophy; and we might therefore commence with inquiring, whether, in this lowest state of information and proof upon the question, there can be anything assigned, which should lead us to move, or at least to look in the opposite direction.

7. In the utter destitution, for the present, of any argument, or even semblance of argument, that a God is—there is, perhaps, a certain duteous movement which the mind ought to take, on the bare suggestion that a God may be. The certainty of an actual God binds over to certain distinct and most undoubted proprieties. But so also may the imagination of a possible God—in which case, the very idea of a God, even in its most hypothetical form, might lay a responsibility, even upon atheists.

8. To make this palpable, we might imagine a family suffering under extreme destitution, and translated all at once into sufficiency or affluence by an anonymous donation. Had the benefactor been known, the gratitude that were due to him becomes abundantly obvious; and in the estimation of every conscience, nothing could exceed the turpitude of him, who should regale himself on the bounties wherewith he had been enriched, and yet pass unheedingly by the giver of them all. Yet does not a proportion of this very guilt rest upon him, who knows not the hand that relieved him, yet cares not to inquire? It does not exonerate him from the burthen of all obligation that he knows not the hand which sustains him. He incurs a guilt, if he do not want to know. It is enough to convict him of a great moral delinquency, if he have gladly seized upon the liberalities which were brought in secret to his door, yet seeks not after the quarter whence they have come—willing that the hand of the dispenser should remain for ever unknown, and not wanting any such disclosures as would lay a distinct claim or obligation upon himself. He altogether lives by the bounty of another; yet would rather continue to live without the burthen of those services or acknowledgments that are due to him. His ignorance of the benefactor might alleviate the charge of ingratitude; but it plainly awakens the charge again, if he choose to remain in ignorance, and

would shun the information that might dispel it. In reference then to this still undiscovered patron of his family, it is possible for him to evince ingratitude; to make full exhibition of a nature that is unmoved by kindness and withholds the moral responses which are due to it, that can riot with utmost selfishness and satisfaction upon the gifts while in total indifference about the giver—an indifference which might be quite as clearly and characteristically shown, by the man who seeks not after his unknown friend, as by the man who slights him after that he has found him.

9. It may thus be made to appear, that there is an ethics connected with theology, which may come into play, anterior to the clear view of any of its objects. More especially, we do not need to be sure of God, ere we ought to have certain feelings, or at least certain aspirations towards him. For this purpose we do not need, fully and absolutely to believe that God is. It is enough that our minds cannot fully and absolutely acquiesce in the position that God is not. To be fit subjects for our present argument, we do not need to have explored that territory of nature which is within our reach; and thence gathered, in the traces of a designer's hand the positive conclusion that there is a God. It is enough if we have not traversed, throughout all its directions and in all its extent, the sphere of immensity; and if we have not scaled the mysterious altitudes of the eternity that is past; nor, after having there searched for a divinity in vain, have come at length to the positive and the peremptory conclusion, that there is not a God. In a word, it is quite enough, that a man is barely a finite creature, who has not yet put forth his faculties on the question whether God is; neither has yet so ranged over all space and all time, as definitely to have ascertained that God is not—but with whom though in ignorance of all proofs, it still remains a possibility that God may be.

10. Now to this condition, there attaches a most clear and incumbent mortality. It is to go in quest of that unseen benefactor, who, for aught I know, has ushered me into existence, and spread so glorious a panorama around me. It is to probe the secret of my being and my birth; and, if possible, to make discovery whether it was indeed the hand of a benefactor, that brought me forth from the chambers of nonentity, and gave me place and entertainment in that glowing territory, which is lighted up with the hopes and the happiness of living men. It is thus that the very conception of a God throws a responsibility after it; and that duty, solemn and imperative duty, stands associated with the thought of a possible deity, as well as with the sight of the present deity, standing in full manifestation before us. Even anterior to all knowledge of God, or when that knowledge is in embryo, there is both a path of irreligion and a path of piety; and that law which denounces the one and gives to the other an approving testimony, may find in him who is still in utter darkness about his origin and his end, a fit subject for

the retributions which she deals in. He cannot be said to have borne disregard to the will of that God, whom he has found. But his is the guilt of impiety, in that he has borne disregard to the knowledge of that God, whom he was bound by every tie of gratitude to seek after—a duty not founded on the proofs that may be exhibited for the being of a God, but a duty to which even the most slight and slender of presumptions should give rise. And who can deny that, antecedent to all close and careful examination of the proofs, there are at least many presumptions in behalf of a God, to meet the eye of every observer? Is there any so hardy as to deny, that the curious workmanship of his frame *may* have had a designer and an architect, that the ten thousand independent circumstances which must be united ere he can have a moment's ease, and the failure of any one of which would be agony, may not have met at random, but that there may be a skilful and unseen hand to have put them together into one wondrous concurrence, and that never ceases to uphold it; that there may be a real and living artist, whose fingers did frame the economy of actual things, and who hath so marvellously suited all that is around us to our senses and our powers of gratification? Without affirming aught which is positive, surely the air that we breathe, and the beautiful light in which we expatiate, these elements of sight and sound so exquisitely fitted to the organs of the human frame-work, *may* have been provided by one who did benevolently consult in them our special accommodation. The graces innumerable that lie widely spread over the face of our world, the glorious concave of heaven that is placed over us, the grateful variety of seasons that like Nature's shifting panorama ever brings new entertainment and delight to the eye of spectators—those may, for aught we know, be the emanations of a creative mind, that originated our family and devised such a universe for their habitation. Regarding these, not as proofs, but in the humble light of presumptions for a God, they are truly enough to convict us of foulest ingratitude—if we go not forth in quest of a yet unknown, but at least possible or likely benefactor. They may not resolve the question of a God. But they bring the heaviest reproach on our listlessness to the question; and show that, anterior to our assured belief in his existence, there lies upon us a most imperious obligation to 'stir ourselves up that we may lay hold of Him.'

11. Such presumptions as these, if not so many demands on the belief of man, are at least so many demands upon his attention; and then, for aught he knows, the presumptions on which he ought to inquire may be more and more enhanced, till they brighten into proofs which ought to convince him. The *prima facie* evidence for a God may not be enough to decide the question; but it should at least decide man to entertain the question. To think upon how slight a variation either in man or in external nature, the whole difference between physical enjoyment and the most acute and most

appalling of physical agony may turn; to think how delicate the balance is, and yet how surely and steadfastly it is maintained, so as that the vast majority of creatures are not only upheld in comfort, but often may be seen disporting themselves in the redundancy of gaiety; to think of the pleasurable sensations wherewith every hour is enlivened, and how much the most frequent and familiar occasions of life are mixed up with happiness; to think of the food, and the recreation, and the study, and the society, and the business, each having an appropriate relish of its own, so as in fact to season with enjoyment the great bulk of our existence in the world; to think that, instead of living in the midst of grievous and incessant annoyance to all our faculties, we should have awoke upon a world that so harmonized with the various senses of man, and both gave forth such music to his ear and to his eye such manifold loveliness; to think of all these palpable and most precious adaptations—and yet to care not, whether in this wide universe there exists a being who has had any hand in them—to riot and regale oneself to the uttermost in the midst of all this profusion—and yet to send not one wishful inquiry after that Benevolence which for aught we know may have laid it at our feet—this, however shaded from our view the object of the question may be, is, from its very commencement, a clear outrage against its ethical proprieties. If that veil of dim transparency, which hides the Deity from our immediate perceptions, were lifted up; and we should then spurn from us the manifested God—this were direct and glaring impiety. But anterior to the lifting of that veil, there may be impiety. It is impiety to be so immersed as we are, in the busy objects and gratifications of life; and yet to care not whether there be a great and a good spirit by whose kindness it is that life is upholden. It needs not that this spirit should reveal himself in characters that force our attention to him, ere the guilt of our impiety has begun. But ours is the guilt of impiety, in not lifting our attention towards God, in not seeking after Him if haply we may find Him.

12. Man is not to blame, if an atheist, because of the want of proof. But he is to blame, if an atheist, because he has shut his eyes. He is not to blame, that the evidence for a God has not been seen by him, if no such evidence there were within the field of his observation. But he is to blame, if the evidence have not been seen, because he turned away his attention from it. That the question of a God may lie unresolved in his mind, all he has to do, is to refuse a hearing to the question. He may abide without the conviction of a God, if he so choose. But this his choice is matter of condemnation. To resist God after that He is known, is criminality towards Him; but to be satisfied that He should remain unknown, is like criminality towards Him. There is a moral perversity of spirit with him who is willing, in the midst of many objects of gratification, that there should not be one object of grati-

tude. It is thus that, even in the ignorance of God, there may be a responsibility towards God. The Discerner of the heart sees, whether, for the blessings innumerable wherewith He has strewed the path of every man, He be treated, like the unknown benefactor who was diligently sought, or like the unknown benefactor who was never cared for. In respect, at least of desire after God, the same distinction of character may be observed between one man and another—whether God be wrapt in mystery, or stand forth in full development to our world. Even though a mantle of deepest obscurity lay over the question of His existence; this would not efface the distinction, between the piety on the one hand which laboured and aspired after Him; and the impiety upon the other which never missed the evidence that it did not care for, and so grovelled in the midst of its own sensuality and selfishness. The eye of a heavenly witness is upon all these varieties; and thus, whether it be darkness or whether it be dislike which hath caused a people to be ignorant of God, there is with him a clear principle of judgment, that He can extend even to the outfields of atheism.

13. It would appear then, that, even in the initial state of the human mind on the question of a God, there is an impellent force upon the conscience, which man ought to obey, and which he incurs guilt by resisting. We do not speak of that light which irradiates the termination of the inquirer's path, but of that embryo or rudimental light which glimmers over the outset of it; which serves at least to indicate the commencement of his way; and which, for aught he knows, may brighten, as he advances onwards, to the blaze of a full and finished revelation. At no point of this progress, does 'the trumpet give an uncertain sound,' extending, if not to those who stand on the ground of Antitheism, (which we have already pronounced upon and we trust proved to be madly irrational)—at least to those who stand on the ground of Atheism, who, though strangers to the conviction, are certainly not strangers to the conception of a Deity. It is of the utmost practical importance, that even these are not beyond the jurisdiction of an obvious principle; and that a right obligatory call can be addressed to men so far back on the domain of irreligion and ignorance. It is deeply interesting to know, by what sort of moral force, even an atheist ought to be evoked from the fastness which he occupies—what are the notices, by responding to which, he should come forth with open eyes and a willing mind to this high investigation; and by resisting which, he will incur a demerit, whereof a clear moral cognisance might be taken, and whereon a righteous moral condemnation might be passed. The "fishers of men" should know the uttermost reach of their argument; and it is well to understand of religion, that, if she have truth and authority at all, there is a voice proceeding from her which might be universally heard—so that even the remotest families

of earth, if not reclaimed by her, are laid by her under sentence of righteous reprobation.

14. On this doctrine of the moral dynamics, which operate and are in force, even in our state of profoundest ignorance respecting God, there may be grounded three important applications.

15. The first is that all men, under all the possible varieties of illumination, may nevertheless be the fit subjects for a judicial cognisance. Their theology, seen through the hazy medium of a dull and imperfect evidence, may have arisen no higher than to the passing suggestion of a God—a mere surmise or rumination about an unseen spirit, who tending all their footeteps, was their guardian and their guide through the dangers of the pathless wilderness. Now in this thought, fugitive though it be, in these uncertain glimpses whether of a truth or of a possibility, there is that, to which the elements of their moral nature might respond—so that to them, there is not the same exemption from all responsibility, which will be granted to the man who is sunk in hopeless idiotism, or to the infant of a day old. Even with the scanty materials of a heathen creed, a pure or a perverse morality might be grounded thereupon—whether, in those longings of a vague and undefined earnestness that arise from him who feels in his bosom an affinity for God and godliness; or, in the heedlessness of him, who, careless of an unknown benefactor, would have been alike careless, although he had stood revealed to his gaze, with as much light and evidence as is to be had in Christendom. These differences attest what man is, under the dark economy of Paganism; and so give token to what he would be, under the bright economy of a full and finished revelation. It is thus that the Searcher of the heart will find out data for a reckoning, even among the rudest of nature's children, or among those whose spiritual light glimmers most feebly. Even the simple theology of the desert can supply the materials of a coming judgment—so that the Discerner of the inner man will be at no loss for a principle, on which He might clearly and righteously try all the men of all the generations that be upon the face of the earth.

16. The second important bearing of this principle is on the subject of religious education. For what is true of a savage is true of a child. Its moral may outrun its argumentative light. Long anterior to the possibility of any sound conviction as to the character or existence of a God, it may respond with sound and correct feeling to the mere conception of Him. We hold, that, on this principle, the practice of early, nay even of infantine religious education, may, in opposition to the invectives of Rousseau and others, be fully and philosophically vindicated. For the effect of this anticipative process is, that, though it do not *at once* enlighten the mind on the question of a God, it at least awakens to the question. It does not consummate the process; but, in as far as the moral precedes the intellectual, it makes good the preliminary steps of the

process—insomuch that, in every Christian land, the youth and the manhood are accountable for their belief, because accountable for their use or their neglect of that inquiry, by which the belief ought to have been determined. They have all from their infancy heard of God. Many have been trained to think of Him, amidst a thousand associations of reverence. Some, under a roof of piety, have often lisped the prayers of early childhood to this unseen Being; and, in the often repeated sound of morning and evening orisons, they have become familiar to His name. Even they who have grown up at random through the years of a neglected boyhood, are greatly within the limits of that responsibility for which we plead. They are fully possessed if not with the certainty, at least with the idea, of a great eternal Sovereign. The very imprecations of profaneness may have taught it to them. The very Sabbath they spend in riot and blasphemy at least remind them of a God. The worship-bell of the church they never enter, conveys to them, if not the truth, at least an imagination of the truth, which, if it do not arrest them by a sense of obligation, will leave guilt upon their souls—though it be guilt against a God who is unknown.

17. But lastly, we may now perceive what that is, on which a teacher of religion finds an introduction for his topic, even into the minds of the people in the lowest state both of moral and intellectual debasement. They may have not that in them, at the outset of his ministrations, which can enable them to decide the question of a God; but they have at least that in them, which should summon all their faculties to the respectful entertainment of it. They have at least such a sense of the divinity, as their consciences will tell, should put them on the regards and the inquiries of moral earnestness. This is a clear principle which operates at the very commencement of a religious course; and causes the first transition, from the darkness and insensibility of alienated nature, to the feelings and attentions of seriousness. The truth is, that there is a certain rudimental theology everywhere, on which the lessons of a higher theology may be grafted—as much as to condemn, if not to awaken the apathy of nature. What we have already said of the relation in which the father of a starving household stands to the giver of an anonymous donation, holds true of the relation in which all men stand to the unseen or anonymous God. Though in a state of absolute darkness, and without one token or clue to a discovery, there is room for the exhibition of moral differences among men—for even then, all the elements of morality might be at work, and all the tests of moral propriety might be abundantly verified; and still more, after that certain likelihoods had arisen, or some hopeful opening had occurred for investigating the secret of a God. There is the utmost moral difference that can be imagined between the man who would gaze with intense scrutiny upon these likelihoods, and the man who either in heedlessness or aversion would turn his eyes from them; between the man who would seize upon such an opening and prosecute such

an investigation to the uttermost, and the man who either retires or shrinks from the opportunity of a disclosure that might burthen him both with the sense and with the services of some mighty obligation.

18. And the same moral force which begins this inquiry, also continues and sustains it. If there be power in the very conception of a God to create and constitute the duty of seeking after Him, this power grows and gathers with every footstep of advancement in the high investigation. If the thought of a merely possible Deity have rightfully awakened a sense of obligation within us to entertain the question; the view of a probable Deity must enhance this feeling, and make the claim upon our attention still more urgent and imperative than at the first. Every new likelihood makes the call louder, and the challenge more incumbently binding than before. In proportion to the light we had attained, would be the criminality of resisting any further notices or manifestations of that mighty Being with whom we had so nearly and so emphatically to do. Under the impulse of a right principle, we should follow on to know God—till, after having done full justice both to our opportunities and our powers, we had made the most of all the available evidence that was within our reach, and possessed ourselves of all the knowledge that was accessible.

19. We can conceive, how, under the influence of these considerations, one should begin and prosecute the study of Natural Theology, till he had exhausted it. But an interesting inquiry remains. We have already endeavoured to estimate what the proper leadings of the mind are, at the commencement and along the progress of the study. The remaining question is, what were the proper leadings of the mind at the termination of it.

20. And first it will be seen, on the principles which we have already endeavoured to establish, that no alleged defect of evidence in Natural Theology can extinguish the use of it—a use which might still remain, under every conceivable degree, whether of dimness or of distinctness in its views. Even the faint and distant probabilities of the subject, may still lay upon us, the duty of careful and strenuous inquiry; and that, long anterior to our full acquaintance with the certainties of the subject. The verisimilitudes of the question are the signal posts, by following the intimations of which, we are at length conducted to the verities of the question. Although Natural Theology therefore should fail to illuminate, yet, by a moral force upon the attention, it may fully retain the power to impel. Even if it should have but some evidence, however slender, this should put us at the very least into the attitudes of inquirers; and the larger the evidence, the more earnest and vigilant ought the inquiry to be. Thus a great object is practically fulfilled by Natural Theology. It gives us to conceive, or to conjecture, or to know so much of God, that, if there be a profest message with the likely signatures upon it of having proceeded from Him—though not our duty all at once to surrender, it is at least our bounden duty to investigate. It may not

yet be entitled to a place in our creed; but it is at least entitled to a place in the threshold of the understanding—where it may wait the full and fair examination of its credentials. It may not be easy to measure the intensity of Nature's light; but enough if it be a light, that, had we obeyed its intimations, would have guided us onwards to larger manifestations of the Deity. If Natural Theology but serve thus to fix and direct our inquiries, it may fulfil a most important part as the precursor of revelation. It may not be itself the temple; but it does much by leading the way to it. Even at the outset period of our thickest ignorance, there is a voice which calls upon us to go forth in quest of God. And in proportion as we advance, does the voice become more urgent and audible, in calling us onward to further manifestations. It says much for Natural Theology, that it begins at the commencement, and carries us forward a part of this way; and it has indeed discharged a most important function, if, at the point where its guesses or its discoveries terminate, it leaves us with as much light, as should make us all awake to the further notices of a God, or as shall leave our heedlessness wholly inexcusable.

21. There is a confused imagination with many, that every new accession, whether of evidence or of doctrine, made to the Natural, tends in so far, to reduce the claims or to depreciate the importance of the Christian Theology. The apprehension is, that as the latter was designed to supplement the insufficiency of the former—then, the more that the arguments of Natural Theology are strengthened, or its truths are multiplied; the more are the lessons of the Christian Theology unheeded and uncalled for. It is thus that the discoveries of reason are held as superseding, or as casting a shade of insignificance, and even of discredit over the discoveries of revelation. There is a certain dread or jealousy, with some humble Christians, of all that incense which is offered at the shrine of the divinity by human science—whose daring incursion on the field of Theology, it is thought, will, in very proportion to the brilliancy of its success, administer both to the proud independence of the infidel, and to the pious alarm of the believer.

22. But to mitigate this inquietude, it should be recollected, in the first place, that, if Christianity have a real and independent evidence of being a message from God, it will be all the more humbly and respectfully deferred to, should a previous natural theology have assured us of his existence, and thrown the radiance of a clear and satisfying demonstration over the perfections of His character. However plausible its credentials may be, we should feel no great interest in its statements or its overtures, if we doubted the reality of that Being from whom it professes to have come; and it is precisely in as far as we are preoccupied with the conviction of a throne in heaven, and of a God sitting upon that throne, that we should receive what bore the signatures of an embassy from Him with awful reverence.

23. But there is another consideration still more decisive of the

place and importance of Christianity, notwithstanding every possible achievement by the light of nature. There are many discoveries which, so far from alleviating, serve but to enhance the difficulties of the question. For example, though science has made known to us the magnitude of the universe, it has not thereby advanced one footstep towards the secret of God's moral administration; but has, in fact, receded to a greater distance, from this now more hopeless, because now more complex and unmanageable problem than before. To multiply the data of a question is not always the way to facilitate its solution; but often the way, rather, to make it more inextricable. And this is precisely the effect of all the discoveries that can be made by natural theology, on that problem which it is the special office of Christianity to resolve. With every new argument by which philosophy enhances the goodness and greatness of the Supreme Being, does it deepen still more the guilt and ingratitude of those who have revolted against Him. The more emphatically it can demonstrate the care and benevolence of God—the more emphatically, along with this, does it demonstrate the worthlessness of man. The same light which irradiates the perfections of the divine nature, irradiates, with more fearful manifestation than ever, the moral disease and depravation into which humanity has fallen. Had natural theology been altogether extinct, and there had been no sense of a law, or lawgiver among men, we should have been unconscious of any difficulty to be redressed, of any dilemma from which we needed extrication. But the theology of nature and conscience tells us of a law; and in proportion as it multiplies the claims of the Lawgiver in heaven, does it aggravate the criminality of its subjects upon earth. With the rebellious phenomenon of a depraved species before our eyes, every new discovery of God, but deepens the enigma of man's condition in time, and of his prospects in eternity; and so makes the louder call for that remedial system, which it is the very purpose of Christianity to introduce into the world.

24. We hold that the theology of nature sheds powerful light on the being of a God; and that, even from its unaided demonstrations, we can reach a considerable degree of probability, both for His moral and natural attributes. But when it undertakes the question between God and man, this is what it finds to be impracticable. It is here where the main helplessness of nature lies. It is baffled in all its attempts to decypher the state and the prospects of man, viewed in the relation of an offending subject to an offended sovereign. In a word, its chief obscurity, and which it is wholly unable to disperse, is that which rests on the hopes and the destiny of our species. There is in it enough of manifestation to awaken the fears of guilt, but not enough again to appease them. It emits, and audibly emits, a note of terror; but in vain do we listen for one authentic word of comfort from any of its oracles. It is able to see the danger, but not the deliverance. It can excite the forebodings of the human spirit, but cannot quell them—knowing just enough to stir the perplexity, but

not enough to set the perplexity at rest. It can state the difficulty, but cannot unriddle the difficulty—having just as much knowledge as to enunciate the problem, but not so much as might lead to the solution of the problem. There must be a measure of light, we do allow; but, like the lurid gleam of a volcano, it is not a light which guides, but which bewilders and terrifies. It prompts the question, but cannot frame or furnish the reply. Natural theology may see as much as shall draw forth the anxious interrogation, “What shall I do to be saved?” The answer to this comes from a higher theology.

25. These are the grounds on which we would affirm the insufficiency of that academic theism, which is sometimes set forth in such an aspect of completeness and certainty, as might seem to leave a revelation or a gospel wholly uncalled for. Many there are who would gloss over the difficulties of the question; and who in the midst of all that undoubted outrage which has been inflicted by sinful creatures on the truth and the holiness and the justice of God, would, by merging all the attributes of the Divinity into a placid and undistinguished tenderness, still keep their resolute hold of heaven, as at least the splendid imagination, by which to irradiate the destinies of our species. It is thus that an airy unsupported romance has been held forth as the vehicle, on which to embark all the hopes and the hazards of eternity. We would not disguise the meagreness of such a system. We would not deliver the lessons of natural theology, without telling at the same time of its limits. We abjure the cruelty of that sentimentalism, which, to hush the alarms of guilty man, would rob the Deity of his perfections, and stamp a degrading mockery upon his law. When expounding the arguments of natural theology, along with the doctrines which it dimly shadows forth, we must speak of the difficulties which itself suggests but which it cannot dispose of; we must make mention of the obscurities into which it runs, but which it is unable to dissipate—of its unresolved doubts—of the mysteries through which it vainly tries to grope its uncertain way—of its weary and fruitless efforts—of its unutterable longings. And should, on the one hand, the speculations of human ingenuity, and on the other, the certainties of a well accredited revelation, come forth to illuminate this scene of darkness—we must not so idolize the light or the sufficiency of nature, as to turn from the firmament’s meridian blaze, that we might witness and admire the tiny lustre of a glow-worm.

26. The two positions are perfectly reconcileable—first of the insufficiency of natural religion; and secondly, the great actual importance of it. It is the wise and profound saying of D’Alembert, that, “Man has too little sagacity to resolve an infinity of questions, which he has yet sagacity enough to make.” Now this marks the degree, in which natural theology is sagacious—being able, from its own resources, to construct a number of cases, which at the same time it is not able to reduce. These must be handed up for solution to a higher calculus; and thus it is, that the theology of nature

and of the schools, the theology of the ethical class—though most unsatisfactory, when treated as a terminating science—is most important, and the germ of developements at once precious and delightful, when treated as a rudimental one. It is a science, not so much of dicta as of desiderata; and, from the way in which these are met by the counterpart doctrines of the gospel, the light of a powerful and most pleasing evidence is struck out by the comparison between them. It is that species of evidence which arises from the adaptation of a mould to its counterpart form; for there is precisely this sort of fitting, in the adjustment which obtains, between the questions of the natural and the responses of the supernatural theology. For the problem which natural theology cannot resolve, the precise difficulty which it is wholly unable to meet or to overcome, is the restoration of sinners to acceptance and favour with a God of justice. All the resources and expedients of natural theology are incompetent for this solution—it being, in fact, the great desideratum which it cannot satisfy. Still it performs an important part in making us sensible of the desideratum. It makes known to us our sin; but it cannot make known to us salvation. Let us not overlook the importance of that which it does, in its utter helplessness as to that which it does not. It puts the question, though it cannot answer the question; and nowhere so much as at this turning-point, are both the uses and the defects of natural theology so conspicuously blended.

27. Natural theology then, however little to be trusted as an informer, yet as an inquirer, or rather as a prompter to inquiry, is of inestimable service. It is a high function that she discharges, for though not able to satisfy the search she impels to the search. We are apt to undervalue, if not to set her aside altogether, when we compare her obscure and imperfect notices with the lustre and the fulness of revelation. But this is because we overlook the virtue that lies in the probabilities of a subject—a virtue, either, on the one hand, to fasten the attention; or, on the other hand, to condemn the want of it. This we hold to be the precise office of natural theology—and an office too, which she performs, not merely as the theology of science among those who listen to her demonstrations in the academic hall; but which she also performs with powerful and practical effect, as the theology of conscience, throughout all the classes of our general population. It is this initial work which makes her so useful, we should say so indispensable, as a preliminary to the gospel. Natural theology is quite overrated by those who would represent it as the foundation of the edifice. It is not that but rather the taper by which we must grope our way to the edifice. The stability of a fabric is not greater than the stability of that upon which it rests; and it were inscribing a general infirmity to revelation, to set it forth, as leaning upon natural theism, in the way that a mathematical doctrine leans upon the axioms or first principles of the science. Chris-

tianity rests upon its own proper evidence; and if, instead of this, she be made to rest on an antecedent natural religion, she becomes weak throughout because weak radically. It is true that in theology, the natural goes before the revealed, even as the cry of weakness or distress goes before the relief to which it aspires, and which it is prompted to seek after. It goes before, not synthetically in the order of demonstration, but historically in the mind of the inquirer. It is not that natural religion is the premises, and Christianity the conclusion; but it is that natural religion creates an appetite which it cannot quell; and he who is urged thereby, seeks for a rest and a satisfaction which he can only obtain in the fulness of the gospel. Natural theology has been called the basis of Christianity. It would accord better with our own views of the place which it occupies, and of the high purpose which it undoubtedly serves—if it were called the basis of Christianization.

28. The most important exemplification of the way in which natural religion bears upon Christianity, is furnished by the question of a sinner's acceptance with God. Natural religion can suggest to man the apprehension of his guilt; for however dim her objective view of the Deity, there is no such dimness in her ethical notion of what is due even to an uncertain God. Without having seriously resolved the question, we may stand convicted to our own minds of a hardened and habitual carelessness of the question. If our whole lives long have been spent in the midst of created things, without any serious or sustained effort of our spirits in quest of a Creator—if, as our consciences can tell, the whole drift and practical earnestness of our thoughts are towards the gifts, with but a rare and occasional anxiety towards the Giver—if the sense of Him touch but lightly on our spirits, and we, by our perpetual lapses from the sacred to the secular, prove that our gravitation is to earth, and that in truth our best-loved element is atheism—if the notices of a God, however indistinct wherewith we are surrounded, instead of fastening our regards on this high contemplation, do but disturb without at all influencing the general tenor of our engagements—these are things of which the light of Nature can take cognisance; and these are things because of which, and of their felt unworthiness, nature is visited by the misgivings both of remorse and of terror. She has data enough on which to found the demonstration and the sense of her own unworthiness; and hence a general feeling of insecurity among all spirits, a secret but strong apprehension that all is not right between them and God.

29. This is not a matter of mere sensitive and popular impression; but in strict accordance with the views of a calm and intelligent jurisprudence. It enters into the very essence of our conception of a moral government, that it must have sanctions—which could not have place, were there either to be no dispensation of rewards and punishments; or were the penalties, though denounced with all the parade and proclamation of law, to be never executed. It is not

the lesson of conscience, that God would, under the mere impulse of a parental fondness for the creatures whom He had made, let down the high state and sovereignty which belong to Him; or that He would forbear the infliction of the penalty, because of any soft or timid shrinking from the pain it would give to the objects of His displeasure. There is nothing either in history or nature, which countenances such an imagination of the Deity, as that, in the relentings of mere tenderness, He would stoop to any weak or unworthy compromise with guilt. The actual sufferings of life speak loudly and experimentally against the supposition; and when one looks to the disease and the agony of spirit, and above all the hideous and unsparing death, with its painful struggles and gloomy forebodings, which are spread universally over the face of the earth—we cannot but imagine of the God who presides over such an economy, that He is not a being who will falter from the imposition of any severity, which might serve the objects of a high administration. Else all steadfastness of purpose, and steadfastness of principle were fallen from. God would stand forth to the eye of His own creatures, a spectacle of outraged dignity. And He of whom we imagine that He dwells in an unviolable sanctuary, the august monarch of heaven and earth—with a law by subjects dishonoured, by the sovereign unrevenged—would possess but the semblance and the mockery of a throne.

30. Such a conception is not only a violence to the apprehensions of nature, but is even acknowledged at times by our academic theists, as a violence to the sound philosophy of the subject. The most striking testimony to this effect is that given by Dr. Adam Smith, on the first appearance of his “*Theory of Moral Sentiments* ;” nor does it detract from its interest or its value, that he afterwards suppressed it in the subsequent editions of his work.—“All our natural sentiments,” he says, “prompt us to believe, that as perfect virtue is supposed necessarily to appear to the Deity as it does to us, as for its own sake and without any further view, the natural and proper object of love and reward, so must vice of hatred and punishment. That the gods neither resent nor hurt was the general maxim of all the different sects of the ancient philosophy; and if by resenting, be understood that violent and disorderly perturbation which often distracts and confounds the human heart; or if by hurting, be understood the doing of mischief wantonly, and without regard to propriety or justice, such weakness is undoubtedly unworthy of the divine perfection. But if it be meant that vice does not appear to the Deity to be for its own sake the object of abhorrence and aversion, and what for its own sake, it is fit and reasonable should be punished, the truth of this maxim can by no means be so easily admitted. If we consult our natural sentiments we are apt to fear lest before the holiness of God, vice should appear to be more worthy of punishment, than the weakness and imperfection of human virtue can ever seem to be of reward. Man when about to appear before a Being

of infinite perfection, can feel but little confidence in his own merit, or in the imperfect propriety of his own conduct. In the presence of his fellow creatures he may often justly elevate himself, and may often have reason to think highly of his own character and conduct, compared to the still greater imperfection of theirs. But the case is quite different, when about to appear before his infinite Creator. To such a Being, he can scarcely imagine, that his littleness and weakness should ever appear to be the proper objects either of esteem or of reward. But he can easily conceive how the numberless violations of duty, of which he has been guilty, should render him the proper object of aversion and punishment; neither can he see any reason why the divine indignation should not be let loose, without any restraint, upon so vile an insect as he is sensible that he himself must appear to be. If he would still hope for happiness, he is conscious that he cannot demand it from the justice; but he must entreat it from the mercy of God, Repentance, sorrow, humiliation, contrition at the thought of his past misconduct, are upon this account the sentiments which become him, and seem to be the only means which he has left, for appeasing that wrath which he knows he has justly provoked. He even distrusts the efficacy of all these, and naturally fears lest the wisdom of God should not, like the weakness of man, be prevailed upon to spare the crime by the most importunate lamentations of the criminal. Some other intercession, some other sacrifice, some other atonement, he imagines must be made for him, beyond what he himself is capable of making, before the purity of the divine justice can be reconciled to his manifold offences. The doctrines of revelation coincide in every respect with these original anticipations of nature; and as they teach us how little we can depend upon the imperfection of our own virtue, so they show us at the same time that the most powerful intercession has been made, and that the most dreadful atonement has been paid, for our manifold transgressions and iniquities."

31. This interesting passage seems to have been written by its author, under a true apprehension of that dilemma in which the world is involved. He admits a moral government on the part of God. He admits a universal delinquency on the part of man. And his feeling is, that the government would be nullified by a mere act of indemnity, which rendered no acknowledgment to the justice which had been violated, or to the authority of that law which had been trampled on. In these circumstances, he casts about as it were for an adjustment; and puts forth a conjectural speculation; and guesses what the provision should be, which, under a new economy, might be adopted for repairing a defect, that is evidently beyond all the resources of natural theism; and proposes the very expedient of our profest revelation, for the resolving of a difficulty which had been else impracticable. We deem it a melancholy fact, that this noble testimony to the need of a gospel, should have disappeared in the posterior editions of his work—revised and corrected as they were

by his own hand. It is not for men to sit in the chair of judgment; and never should they feel a greater awe or tenderness upon their spirits, than when called to witness or to pronounce upon the aberrations of departed genius. Yet when one compares the passage he could at one time have written, with the memoir that, after an interval of many years, he gave to the world of David Hume, that ablest champion of the infidel cause—one fears lest, under the contagion of a near and withering intimacy with him, his spirit may have imbibed of the kindred poison; and he at length have become ashamed, of the homage that he once had rendered to the worth and importance of Christianity.

32. This notwithstanding remains one of the finest examples of the way, in which the Natural bears upon the Christian theology; and of the outgoings, by which, the one conducts to a landing-place in the other. We hold that there are many such outgoings; that at the uttermost margin of the former there is a felt want, and that in accurate counterpart to this, the latter has something to offer in precise and perfect adaptation thereto. Now the great error of our academic theism, as commonly treated, is that it expresses no want; that it reposes in its own fancied sufficiency; and all its landing-places are within itself, and along the uttermost limits of its own territory. It is no reproach against our philosophical moralists, that they have not stepped beyond the threshold of that peculium, which is strictly and appropriately theirs; or not made incursion into another department than their own. The legitimate complaint is, that, on taking leave of their disciples, they warn them not, of their being only yet at the outset or in the prosecution of a journey, instead of having reached the termination of it. They in fact take leave of them, in the middle of an unprotected highway—when they should have reared a finger post of direction to the places which lie beyond. The paragraph which we have now extracted, was just such a finger post—though taken down, we deeply regret to say, by the very hand that had erected it. Our veneration for his name must not restrain the observation, that, by this, he undid the best service which a professor of moral science can render to humanity. Along the confines of its domain, there should be raised, in every quarter, the floating signals of distress, that its scholars, instead of being lulled into the imagination that now they may repose as in so many secure and splendid dwelling places, should be taught to regard them only as towers of observation—whence they have to look for their ulterior guidance and their ulterior supplies, to the region of a conterminous theology.

33. There is a difficulty here in the theism of nature, within the whole compass of which, no solution for it can be found. It will at least afford a specimen of the way in which the one bears upon the other, if we state the method of escape from this difficulty that has been provided in the theism of Christianity. The great moral problem which under the former waits to be resolved, is to find accept-

ance in the mercy of God, for those who have braved His justice, and done despite to the authority of His law, and that, without any compromise of truth or dignity. By the offered solution of the New Testament, a channel has been opened up, through a high mediatorship between God and man, for the descent of a grace and a mercy the most exuberant on a guilty world; and through it, the overtures of reconciliation are extended unto all; and a sceptre of forgiveness, but of forgiveness consecrated by the blood of a great atonement, has been stretched forth, even to the most polluted and worthless outcasts of the human family; and thus the goodness of the divinity obtained its fullest vindication, yet not a goodness at the expense of justice—for the affront done to an outraged law, has been amply repaired by the homage to its authority of an illustrious sufferer, who took upon himself the burthen of all those penalties which we should have borne; and, in the spectacle of whose deep and mysterious sacrifice, God's hatred of moral evil stands forth in most impressive demonstration. So that, instead of a conflict or a concussion between these two essential attributes of His nature, a way has been found, by which each is enhanced to the uttermost, and a flood of most copious and convincing illustration has been poured upon them both.

34. This specimen will best illustrate of moral philosophy, even in its most finished state, that it is not what may be called a terminating science. It is at best but a science *in transitu*; and its lessons are those of a preparatory school. It contains but the rudiments of a nobler acquirement; and he discharges best the functions of a teacher, not who satiates but who excites the appetite, and then leaves it wholly unappeased. This arises from the real state and bearing of the science, as being a science, not so much of doctrines as of desiderata. At most it leaves its scholars in a sort of twilight obscurity. And, if a just account is rendered of the subject, there will unavoidably be the feeling, that, instead of having reached a secure landing-place, we have broken off, as in the middle of an unfinished demonstration.

35. That indeed is a most interesting adjustment between Moral Philosophy and the Christian Theology, which is represented to us by the unresolved difficulties of the one science, and the reduction which is made of these difficulties in the other. We have far the most important example of this, in the doctrine of the atonement—that sublime mystery, by which the attributes of the divinity have all been harmonized; and the most liberal outlet has been provided for mercy to the offender, while still the truth and justice of the Lawgiver have been vindicated, and all the securities of His moral government are upholden. By the disloyalty of our race, the principles of Heaven's jurisprudence are brought to a test of utmost delicacy; for there seems to be no other alternative, than that man should perish in overwhelming vengeance, or that God should become a degraded sovereign. It nullifies the moral government of the

world, if all force and authority be taken from its sanctions; and it is a problem which even "angels desired to look into," how the breach could be healed, which had been made by this world's rebellion, and yet the honour of heaven's high Sovereign be untarnished by the compromise. The one science lands us in the difficulty; and by the other alone it is, that we are extricated. The one presents us with the case; but, for the solution of it, we must recur to a higher calculus, to an instrument of more powerful discovery and of fuller revelation. The one starts a question which itself cannot untie; and the other furnishes the satisfactory response to it. The desideratum of the former meets with the doctrine of the latter; and it is this frequent adjustment, as of a mould to its counterpart die; it is this close and manifold adaptation between the wants of nature and the overtures of a profest revelation; it is this fitting of the supernal application to the terrestrial subject upon which it is laid; it is the way, more especially, in which the disruption between heaven and earth has been restored, and the frightful chasm that sin had made on the condition and prospects of our species is wholly repaired to all who will through the completeness of an offered Saviour; it is this mingled harmony of the greater and lesser lights, which gives evidence that both have been kindled by the same hand, and that it is He who put the candle which glimmers so feebly into my heart, it is He also who poured the noonday effulgence of Christianity around me.

36. It were foreign to our prescribed subject to attempt an exposition, in however brief and rapid a sketch, of the credentials of Christianity. We only remark, that, amid the lustre and variety of its proofs, there is one strikingly analogous, and indeed identical in principle, with our own peculiar argument. If in the system of external nature, we can recognise the evidence of God being its author, in the adaptations wherewith it teems to the Moral and Intellectual Constitution of Man—there is room and opportunity for this very evidence in the book of an external revelation. What appears in the construction of a world might be made to appear as manifestly in the construction of a volume, whose objective truths may present as obvious and skilful an accommodation to our mental economy, as do the objective things of a created universe. And it is not the less favourable, for an indication of its divine original that whereas Nature, as being the original system, abounds with those fitnesses which harmonize with the mental constitution in a state of health—Christianity, as being a restorative system, abounds in fitnesses to the same constitution in a state of disease. We are not sure but that in the latter, from its very design, we shall meet with still more delicate and decisive tests of a designer, than have yet been noticed in the former; and certain it is, that the wisdom and goodness and even power of a moral architect, may be as strikingly evinced in the reparation, as in the primary establishment of a Moral Nature.

THE BRIDGEWATER TREATISES

ON THE

POWER, WISDOM, AND GOODNESS OF GOD, AS MANIFESTED
IN THE CREATION.

TREATISE VIII.

CHEMISTRY, METEOROLOGY, AND THE FUNCTION OF DIGESTION.

BY WILLIAM PROUT, M. D. F. R. S.

Μὴ ὑπαρχούσας γὰρ ἀρμονίας, καὶ ἘΠΟΨΙΟΣ ΘΕΙ'ΑΣ περὶ τὸν κόσμον εὐκ' ἂν
ιδύνατο συνεῖμεν ἔτι καλῶς ἔχοντα τὰ ἐγκεκοσμημένα.

HIPPODAMUS DE FELICITATE.

CHEMISTRY, METEOROLOGY,

AND

THE FUNCTION OF DIGESTION,

CONSIDERED

WITH REFERENCE TO NATURAL THEOLOGY.

BY

WILLIAM PROUT, M.D.F.R.S.,

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS.

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1836

THE UNIVERSITY OF CHICAGO



1925

Harvey Arnold

1925

Harvey Arnold

TO

DAVIES GILBERT, ESQ.,

LATE PRESIDENT OF THE ROYAL SOCIETY,

THIS VOLUME

IS

RESPECTFULLY INSCRIBED.

NOTICE.

THE series of Treatises, of which the present is one, is published under the following circumstances :

THE RIGHT HONOURABLE and REVEREND FRANCIS HENRY, EARL of BRIDGEWATER, died in the month of February, 1829 ; and by his last Will and Testament, bearing date the 25th of February, 1825, he directed certain Trustees therein named to invest in the public funds the sum of Eight thousand pounds sterling ; this sum, with the accruing dividends thereon, to be held at the disposal of the President, for the time being, of the Royal Society of London, to be paid to the person or persons nominated by him. The Testator further directed, that the person or persons selected by the said President should be appointed to write, print, and publish one thousand copies of a work *On the Power, Wisdom, and Goodness of God, as manifested in the Creation ; illustrating such work by all reasonable arguments, as for instance the variety and formation of God's creatures in the animal, vegetable, and mineral kingdoms ; the effect of digestion, and thereby of conversion ; the construction of the hand of man, and an infinite variety of other arguments ; as also by discoveries ancient and modern, in arts, sciences, and the whole extent of literature.* He desired, moreover, that the profits arising from the sale of the works so published should be paid to the authors of the works.

The late President of the Royal Society, Davies Gilbert, Esq. requested the assistance of his Grace the Archbishop of Canterbury and of the Bishop of London, in determining upon the best mode of carrying into effect the intentions of the Testator. Acting with their advice, and with the concurrence of a nobleman immediately connected with the deceased, Mr. Davies Gilbert appointed the following eight gentlemen to write separate Treatises on the different branches of the subject, as here stated :

THE REV. THOMAS CHALMERS, D. D.

PROFESSOR OF DIVINITY IN THE UNIVERSITY OF EDINBURGH.

ON THE ADAPTATION OF EXTERNAL NATURE TO THE MORAL AND INTELLECTUAL
CONSTITUTION OF MAN.

JOHN KIDD, M. D. F. R. S.

REGIUS PROFESSOR OF MEDICINE IN THE UNIVERSITY OF OXFORD.

ON THE ADAPTATION OF EXTERNAL NATURE TO THE PHYSICAL CONDITION OF MAN.

THE REV. WILLIAM WHEWELL, M. A. F. R. S.

FELLOW OF TRINITY COLLEGE, CAMBRIDGE.

ON ASTRONOMY AND GENERAL PHYSICS CONSIDERED WITH REFERENCE TO NATURAL
THEOLOGY.

SIR CHARLES BELL, K. H. F. R. S. L. & E.

THE HAND : ITS MECHANISM AND VITAL ENDOWMENTS AS EVINCING DESIGN.

PETER MARK ROGET, M. D.

FELLOW OF AND SECRETARY TO THE ROYAL SOCIETY.

ON ANIMAL AND VEGETABLE PHYSIOLOGY.

THE REV. WILLIAM BUCKLAND, D. D. F. R. S.

CANON OF CHRIST CHURCH, AND PROFESSOR OF GEOLOGY IN THE UNIVERSITY OF OXFORD.

ON GEOLOGY AND MINERALOGY.

THE REV. WILLIAM KIRBY, M. A. F. R. S.

ON THE HISTORY, HABITS, AND INSTINCTS OF ANIMALS.

WILLIAM PROUT, M. D. F. R. S.

ON CHEMISTRY, METEOROLOGY, AND THE FUNCTION OF DIGESTION.

HIS ROYAL HIGHNESS THE DUKE OF SUSSEX, President of the Royal Society, having desired that no unnecessary delay should take place in the publication of the above-mentioned treatises, they will appear at short intervals, as they are ready for publication.

TO THE READER.

CHEMISTRY has not hitherto been considered in detail with reference to Natural Theology : the difficulties, therefore, incidental to a first attempt, added to those arising from the nature of Chemistry itself as a science, must be the apology of the author for numerous imperfections in this treatise.

The peculiar chemical opinions advanced, would never have appeared in their present form ; had not the author been strongly impressed with the belief that they are calculated, sooner or later, to bring chemical action under the dominion of the laws of quantity ; and had he not despaired, under his professional engagements, of being himself able to submit them to experimental proof. These opinions, however, have been always introduced as mere illustrations.

The argument of design is necessarily cumulative ; that is to say, is made up of many similar arguments. To avoid repetitions therefore, the illustration of principles rather than of details, has been studied ; and the application of particular facts to the argument, has been often left to the reader.

LONDON, *February 3, 1834.*

THE STATE OF NEW YORK
IN SENATE

January 15, 1901.

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OF THE

COMMISSIONERS OF THE LAND OFFICE

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The second part of the book is a detailed account of the history of the world from the beginning of the Christian era to the present day. It covers the history of the Roman Empire, the Middle Ages, the Renaissance, the Reformation, and the modern world. The author discusses the various events and movements that have shaped the world, and the role of the individual in history. He also touches upon the various theories of history and the methods of historical research.

The third part of the book is a critical examination of the various theories of history and the methods of historical research. The author discusses the different schools of thought, such as the positivist, the idealist, and the materialist, and the different methods of historical research, such as the comparative method, the evolutionary method, and the functional method. He also touches upon the various problems and controversies in the history of the world, and the role of the individual in history.

The fourth part of the book is a summary of the main points of the history of the world, and a discussion of the future of the world. The author discusses the various theories of the future of the world, and the role of the individual in the future. He also touches upon the various problems and controversies in the history of the world, and the role of the individual in history.

INTRODUCTION.

OF THE LEADING ARGUMENT OF NATURAL THEOLOGY; THAT DESIGN, OR
THE ADAPTATION OF MEANS TO AN END, EXISTS IN NATURE.

WITH the view of illustrating the argument of design, we shall commence with a statement of that argument in its simplest form.

Animals in cold climates have been provided with a covering of fur. Men in such climates cover themselves with that fur. In both cases, whatever may have been the end or object, no one can deny that the *effect*, at least, is precisely the same: the animal and the man are alike protected from the cold. Now, since the animal did not clothe itself, but must have been clothed by another; it follows, that whoever clothed the animal, must have known what the man knows, and must have reasoned like the man; that is to say, the clother of the animal must have known that the climate in which the animal is placed, is a cold climate; and that a covering of fur, is one of the best means of warding off the cold; he therefore clothed his creature in this very appropriate material.

The man who clothes himself in fur to keep off the cold, performs an act directed to a certain end; in short, an act of *design*. So, whoever, directly or indirectly, caused the animal to be clothed with fur to keep off the cold, must likewise have performed an act of *design*.

But, under the circumstances, the clother of the animal, must be admitted to have been also the *Creator* of the animal; and by extending the argument; the Creator of man himself—of the universe. Moreover, the reasoning the Creator has displayed in clothing the animal, He has designed to impart to man, who is thus enabled to recognise his Creator's design.

Such is an instance of those varied adaptations of means to ends around him, which man by his reasoning appreciates; and which demonstrate to him, the existence of an intelligent Creator. Compared, however, with the extent of creation, the instances, numerous as they appear, in which man is thus able to trace the designs of his Creator, are really few. Man not only sees means directed to certain ends; but ends accomplished by means, which he is totally unable to understand. He also sees, everywhere, things, the nature, and the end of which are ut-

terly beyond his comprehension ; and respecting which, he is obliged to content himself with simply inferring the existence of design.

The argument of design, therefore, in its general sense, embraces at least three classes of objects:—

1. Those objects, regarding which, the reasoning of man coincides with the reasoning evinced by his Creator; as in the simple adaptation of clothing above-mentioned: or those objects, in which, man is able to trace, to a certain extent, his Creator's designs; as in various phenomena amenable to the laws of quantity; viz. mechanics, &c.

2. Those objects, in which, man sees no more than the preliminaries and the results, or the end and design accomplished; without being able to trace through their details, the means of that accomplishment; as in all the phenomena and operations of chemistry.

3. Those objects, in which, design is inferred, but in which the design, as well as the means by which it is accomplished, are alike concealed; as in the existence of fixed stars, of comets, of organized life: and indeed in all the great and more recondite phenomena of nature.

The intention of these Treatises, is to point out the various evidences of design, among the objects of creation; and to deduce from them, the existence, and the attributes, of the Creator. The following pages are occupied more particularly, with the illustration of the evidences of design, in objects belonging to the second of the three classes above-mentioned; with those, namely, in which design is obvious, though we cannot trace the means by which that design is accomplished.

BOOK I.

OF CHEMISTRY.

PRELIMINARY OBSERVATIONS ON THE RANK OF CHEMISTRY AS A SCIENCE;
AND ON ITS APPLICATION TO THE ARGUMENT OF DESIGN.

“CHEMISTRY does not afford the same species of argument (in favour of design) that mechanism affords, and yet may afford an argument in a high degree satisfactory.”* This remark of the excellent Paley has been made by him with reference only to a particular subject, but the following sketch, pointing out the grounds upon which chemistry as a science is founded, and the rank which it holds among the departments of human knowledge, will at the same time show the general truth of the remark.

An elaborate inquiry into the origin and nature of human knowledge would be quite misplaced here. We shall content ourselves with simply considering it as of two kinds, viz: a knowledge of what *must be*; that is to say of what we cannot conceive either not to exist, or to exist otherwise than as it is, and which is therefore founded upon reason; and a knowledge of what simply *is*, but how or why we know not, and for the existence of which, therefore, we can assign no reason but our experience alone.

Of these, the only instance of the first kind which particularly concerns us at present, is the knowledge of *quantity* and its relations in general; of the second, that of certain natural phenomena, the consideration of which constitutes the principal object of the present volume.

The fundamental differences between these two great branches of human knowledge, as well as their consequences, cannot perhaps be more strikingly illustrated than in the following familiar exposition by a celebrated writer. “A clever man,” says Sir J. Herschel, “shut up alone and allowed unlimited time, might reason out for himself all the truths of mathematics, by proceeding from those simple notions of space and number of which he cannot divest himself without ceasing to think; but he would never tell by any effort of reason what would become of a lump of sugar, if immersed in water, or what impression would be produced on his eye by mixing the colours yellow and blue,”† results which can be learnt only from experience.

* Natural Theology, chap. vii.

† Discourse on the Study of Natural Philosophy, p. 76.

Thus then the extremes of human knowledge may be considered as founded on the one hand purely upon reason, and on the other purely upon sense. Now, a very large portion of our knowledge, and what in fact may be considered as the most important part of it, lies between these two extremes, and results from a union or mixture of them, that is to say, consists of the application of rational principles to the phenomena presented by the objects of nature.

With respect to knowledge founded upon *reason*, we are so constituted, that whether we contemplate those primary notions of space, time, force, &c. above alluded to in the abstract, or whether we view them in connexion with the objects of sense around us, we cannot divest them of *quantity*, which seems to be involved in their very essence. Quantity and its relations, therefore, in some shape or other, enter as a necessary element into by far the greater portion of human knowledge. Now the primary relations of quantity are exceedingly simple; one quantity may be equal to another, or it may be greater or less, but we can conceive no other relation. Hence all the operations of the mathematics—the science of quantity and its relations—however abstruse and complicated they appear can be ultimately resolved into addition and subtraction.

It is principally then through the medium of the relations of quantity that we are enabled to reason in a satisfactory manner upon the objects of sense. For us everything in nature, or what is the same thing to us, every sensation produced by one natural object, as compared with that produced by another, must be either equal or similar, or unequal or dissimilar; the whole are capable of being subjected, more or less perfectly, to the laws of quantity. This is effected in various ways and by various artifices, but chiefly through the intervention of certain natural or assumed units, or standards of resemblance, as a second in time, a foot in space, &c. and in proportion to the definite character of these units, or standards, and as they can be more or less satisfactorily applied, so will the resulting branch of knowledge be more or less of a mathematical character, or be more or less rational and perfect.

By contemplating, in the abstract, the boundless relations of time and of space, where no end can be conceived to addition and subtraction, we arrive at the only notions of infinity of which our nature seems capable. These once obtained, the obvious and necessary existence of cause within the narrow sphere of our observation naturally leads us to inquire, can this cause be infinite? And thus we are led by degrees, but irresistibly, to the sublimest of all conclusions, that a Cause or Agent in every way commensurate with infinity—omniscient and omnipresent, eternal and omnipotent must exist—in other words a God.

Compared with infinity, however, and even with the objects of nature as they visibly exist around us, our actual knowledge of time

and of space is exceedingly limited. Like travellers on an extended plain, we see what is going on around us at the present moment, but the distant and the very near, the past and the future, are alike unknown to us. A few millions of miles, for example, or a few thousand years, comprise the utmost that we know of space and of time. On the other hand, beyond the fraction of an inch, or of a second, everything belonging to space and time is inappreciable by our senses. Yet beyond these limits we *know* that myriads of portions of space and of time must exist, too vast or too minute to be referred to our imperfect standards. Let us, for instance, take the distance of the nearest fixed star. This we are assured by astronomers is so great that the utmost measure we can apply to it—the diameter of the earth's orbit—a space of no less than 192,000,000 of miles is absolutely too little to measure it by—is in fact contained within it so many times that the number cannot at present be counted! On the other hand, we shall presently find, that the molecules of matter of which the objects we see around us are composed are so minute, that a measure scarcely appreciable by the unassisted sight, the thousandth part of an inch for example, is vastly too large to compare them with, and may in fact comprise millions of them!

Experience, the great and ultimate source of all the knowledge we possess of those portions of nature to which our faculties are limited may be acquired in two ways; by simple observation, and by experiment; that is to say, either “by noticing facts as they occur without any attempt to influence the frequency of their occurrence, or to vary the circumstances under which they occur;” or “by putting in action causes and agents over which we have control, and purposely varying these combinations, and noticing what effects take place.”* Now in all the higher departments of knowledge the objects of which are principally matter, and its motions in the aggregate, the information we can acquire by one or both these means is so complete, and at the same time so favourable to the application of the relations of quantity, that the resulting sciences have all the certainty of abstract truths themselves. But when the knowledge we possess of objects is wholly sensible, and in no way commensurate, or only very imperfectly so with their quantity, here it is that uncertainty begins; for though we may be able to trace the apparent *cause* and *effect* of a particular phenomenon, the most minute and careful observation and experiment, often give us but little insight into the connexion between the two, and generally fail us altogether. The reason of this is to be sought for in the limited nature of our faculties, and particularly in our complete ignorance of the nature of that mysterious communication which we maintain with the external world through the medium of sensation. In two

* Herschel's Discourse on the Study of Natural Philosophy, p. 76.

of the senses indeed, *seeing* and *hearing*, we are able to trace the intermediate train of phenomena between the external object producing the sensation and the sensation itself, and even to form some idea of the remote cause of the sensation; but in the other two senses, *tasting* and *smelling*, the whole is involved in mystery from beginning to end.

Thus when a bell is struck, philosophers have satisfactorily demonstrated that a vibratory motion, excited in the bell, and depending upon its elasticity, is communicated to the air in contact with it, and through this medium is propagated to the ear, in which organ, we know not why, the sensation of sound is excited. Circumstances very similar have been supposed to take place with respect to light, and *undulæ* (or something obeying the laws of *undula*) have been demonstrated to exist and to be propagated from the luminous body to the eye, and thus the remote cause of sound, and probably of light, is proved to be motion. But in the cases of *tasting* and *smelling* the circumstances are altogether dissimilar; here the sapid and odoriferous matters are brought at once into actual contact with the sentient organs, and the sensations are the consequence without any intermediate train of phenomena, at least any that we can appreciate. What it is therefore in an acid or a rose for example, analogous to motion in the bell, and which produces the sensations we call *sour* and *sweet* we know not, and probably never shall know, and simply because the laws and relations of quantity are here either totally inapplicable, or can be only indirectly and most imperfectly applied.

These observations are principally introduced with reference to the department of knowledge we have at present to consider. Almost all of what are denominated the *chemical* properties of bodies, are objects of taste and of smell, rather than of sight and of hearing. Hence they admit only of the indirect application of the laws of quantity, and are the result, not of reason but solely of experience. Indeed, so much is chemistry the creature of actual experimental research, that its simplest truths have seldom been anticipated *a priori*. Thousands of years of observation and experience for example had not taught mankind that water is composed of two elementary gaseous principles, much less the proportions in which those principles combine to form water. Nay, even now the fact has been established upon the clearest evidence, we are unable to explain why it is so, or even to comprehend the nature of the union or its result. Hence, to use the language of Paley, in all chemical operations—"our situation is precisely like that of an unmechanical looker-on, who stands by a machine, the fabric of which is hidden from his sight by the outside case, or if seen, would be too complicated for his uninformed understanding to comprehend. And what," continues this energetic writer, "is that situation? Ignorant as he is, he does not fail to see that certain materials, in passing

through the machine, undergo remarkable changes; and what is more, changes manifestly adapted for future use. It is necessary that this man, in order to be convinced that design, that intention, that contrivance, have been employed about the machine, should be allowed to pull it to pieces to study its construction? He may indeed wish to do this for many reasons, but for all the purposes of ascertaining the existence of counsel and design in the formation of the machine, he wants no such intromission or privity. What he sees is sufficient. The effect upon the material, the change produced in it, the utility of that change for further applications abundantly testify, be the concealed part of the machine, or of its construction what it will, the hand and agency of a contriver."*

We have thus attempted to point out the rank which chemistry holds among human knowledge, and the kind of evidence which it furnishes in favour of design; and the whole argument may be briefly recapitulated as follows: chemistry is a branch of knowledge founded solely on experience, for the phenomena of which we can assign no reason. But although the intimate nature of its changes be unknown to us, we see them manifestly directed to certain ends; hence as objects directed to certain ends, where the whole of the intermediate phenomena can be traced and understood, always imply design, we naturally infer design in others obviously so directed, even although we may not be able to understand their intimate nature.

Such is the state in which Paley has left the argument, and while we admit that even in its most perfect form, it is less satisfactory than that founded upon mechanism, we have always thought that our excellent author has not made quite so much of his subject as he might have done, and that the very imperfections and difficulties of chemistry and of the allied branches of knowledge give them some advantages over mechanism itself. When a series of wheels or of levers are arranged in a certain order, they *must* move, in a certain way, and produce a certain effect which can be foretold exactly. In such a case, we may admire the skill and ingenuity of the Contriver, or perhaps feel astonished at his power, but we scarcely do more, and much of the effect is lost in the apparent necessity of the result, and the consciousness that under the circumstances nothing else could have happened. When the Deity, therefore, operates through the medium of mechanism, he appears almost too obviously to limit his powers within the trammels of necessity; but when he operates through the medium of chemistry, the laws of which are less obvious, and indeed for the most part unknown to us, his operations have much more the character of those of a free agent, and, in many instances also, appear of a higher order, and

* Natural Theology, chap. vii. condensed slightly, but the argument strictly adhered to.

are more striking and wonderful. Do not, for instance, those extraordinary and mysterious changes constantly going on around us, beneath us, within us, derive no small additional interest from the very circumstances of their not being understood? Just such an interest, to revert to the argument of Paley, as the unmechanical looker-on feels in the operations of a corn-mill, a carding-machine, or a threshing machine, and to which he who is well acquainted with the mechanism is a stranger. Certainly this is the case. Obvious mechanism, though well-suited to display the intelligence and design of the Contriver, is not always so well adapted for arresting the attention of the observer; its very obviousness in some measure depriving it of its interest. But when we see the same Contriver, besides the most beautiful and complicated mechanism, employ other means utterly above *our* comprehension, though evidently most familiar to *him*, the circumstance is not only calculated to arrest our attention more forcibly, but at the same time to impress us with more exalted notions of his wisdom and power.

There yet remain one or two other points to be briefly considered before we proceed to our subject. In the first place it may be asked, do those extraordinary changes which appear to be constantly going on in bodies around us, indicate real and substantial changes in the bodies themselves, or are they mere phantasms and creations of the organs of sense, through which we become acquainted with them? The discussion of this question will probably be considered by most as superfluous, but for the sake of those (if there be any) who entertain doubts upon the point, it may be remarked, that the sensations, though admitted to be mere signals or indications, bearing little or no analogy with the causes producing them, and therefore throwing little light upon their nature, do nevertheless represent real and substantial operations of some sort in the bodies themselves. This might be proved were it necessary by a variety of arguments, but one or two only will be sufficient for our present purpose. In the first place it may be stated, that changes in the chemical constitution of bodies are usually accompanied by corresponding changes in *weight*. Now weight is a modification of *force*, one of those self-evident existences which we cannot doubt without doubting our own. Another, and perhaps indeed the most striking argument in favour of the reality of chemical changes, may be deduced from the subserviency to them of those mechanical contrivances and operations everywhere existing in organized beings. At least, half the mechanism in a living animal is subservient to the chemical changes constantly going on in it, and necessary to its existence. Take, for instance, the circulation of the blood: what a complicated apparatus is here employed for the simple purpose of exposing the blood to the action of the air in the lungs, in order that it may there undergo some chemical change. Now, surely no one can reasonably doubt that this chemical change is as much a reality

as the mechanism by which it has been accomplished; and if *one* chemical change be admitted to be a reality, why may not all others?

Lastly, if there be any one who denies the existence of design, and sees nothing in all the more obvious arrangements and order around him but the necessary results of what he chooses to denominate "the laws of nature," let him calmly and deliberately consider the facts brought forward in the following pages; and if he can witness unconvinced all the numerous instances of prospective arrangement obviously made with reference to things not yet in existence; all the beautiful adjustments and adaptations of noxious and conflicting elements most wonderfully conspiring together for good; and, lastly, the subversion of even his favourite "laws of nature" themselves, when a particular purpose requires it; if, we say, he can witness all these and still remain incredulous of the evidences of design, we can only observe, that his mind must be most singularly constituted, and apparently beyond the reach of conviction.

CHAPTER I.

OF THE MUTUAL OPERATION OF PHYSICAL AGENTS AND OF MATTER, AND OF THE LAWS WHICH THEY OBEY.

"God has been pleased to prescribe limits to his own power, and to work his ends within those limits. The general laws of matter have perhaps the nature of these limits; its *inertia*, its reaction, the laws which govern the communication of motion, of light, of heat, of magnetism and electricity, and probably of others yet undiscovered. These are general laws, and when a particular purpose is to be effected, it is not by making them wind and bend and yield to the occasion, (for nature with great steadiness adheres to and supports them,) but it is, as we have seen in the eye, by the interposition of an apparatus corresponding with these laws, and suited to the exigency which results from them, that the purpose is at length attained. As we have said, therefore, God prescribes limits to his power, that he may let in the exercise, and thereby exhibit demonstrations of his wisdom. For then, *i. e.* such laws and limitations being laid down, it is as though one Being should have fixed certain rules; and, if we may so speak, provided certain materials; and afterwards have committed to another Being, out of these materials, and in subordination to these rules, the task of drawing forth a creation: a supposition which evidently leaves room, and induces indeed a necessity for contrivance. Nay, there may be many such agents, and many

ranks of these.”* This admirable passage from Paley is so much in point, and so exactly expresses our views upon the subject, that we have chosen it as a text, as in a former instance, for illustration. We shall proceed, therefore, to take a summary view of “the limits within which the Deity has confined his operations;” that is to say, of the laws by which matter, and these subordinate agents by which it is capable of being influenced, have been made to mutually act and react upon each other.

The principles of activity which operate as subordinate agencies in nature may be considered as of two kinds; those which operate universally upon every individual atom of matter without reference to its sensible properties, as the forces producing the phenomena of *gravitation*, &c.; and those which operate among the different constituent molecules of which all bodies are composed, and which are denominated *molecular* or *polarizing* forces, &c. Of each of these we shall in the first place endeavour to convey some idea to the general reader.

CHAPTER II.

ON THE INERTIA AND ACTIVITY OF MATTER.

To form a notion of what is termed the *inertia* or inactivity of matter, let us imagine a portion of it, as for example, a ball of lead A detached from all other matter, and existing absolutely uninfluenced in space. Such a mass of matter, if supposed to be at rest, must obviously remain so, for it cannot move itself; on the other hand, if it be supposed to be in motion, it must continue in motion, for it cannot be conceived to be able to stop itself any more than it could be conceived to be able to set itself in motion; in short, a mass of matter under such circumstances of isolation must be considered as perfectly passive and unable to change its state, whatever that may happen to be, whether of motion or of rest. Now let us suppose another portion of matter, as for example, another ball of lead B exactly of the same size as A, placed in a free space at any moderate distance from A, and away from all other influences, what will happen? We know from general experience that under these circumstances, the two balls will mutually approach each other with an accelerated motion, till they meet at a point exactly intermediate from those at which they first started; and the inference from this experience is, that the two balls exert a mutual and equal attractive force, which

* Natural Theology, chap. iii.

causes them to move towards each other. If the ball B be twice the size of the ball A, the two balls will mutually approach each other as before, but, in this instance, instead of moving with equal velocity, while the ball A moves two feet, the ball B will only move one foot; or taking an extreme case, and supposing the ball B to be indefinitely larger, say a million times larger, than the ball A, they will mutually influence and mutually move towards each other as before, but the motion of the ball B will be so minute as to be insensible, while that of the ball A will be the greatest possible. Here we have instances of the *inertia* (inactivity, opposing force, &c.) and of the activity (force of attraction, force of gravitation, &c.) which all matter exerts reciprocally and mutually towards all other matter, and the laws of which, as deducible from the circumstances stated, and from others, which it would be foreign to our present purpose to enter upon, may, in general terms, be given as follows: "The mutual attraction of two bodies increases in the same proportion as their masses are increased, and as the square of their distance is decreased, and it decreases in proportion as their masses are decreased and as the square of their distance is increased." These laws, and those of the motions connected with them, are absolutely general, and not only extend to the utmost limits of the universe hitherto explored by man, but to every form and condition of matter, without exception and without reference to its other properties. They, therefore, constitute, probably, the most comprehensive "limits which the Deity has been pleased to prescribe to His power," and within which He operates with the most unceasing and undeviating regularity and certainty; they have also the remarkable property of being so amenable to the laws of quantity and mathematics, as to be in most instances as firmly established upon reason as abstract truths themselves. The mind of a Newton was chosen to reveal these laws to man, and man's acquaintance with them may be justly considered as one of his noblest privileges. To point out their wonders in detail, and the sublime conclusions to which they lead, is the business of a colleague; at present we have to consider them in their more general form only, and, except in a single point of view, as objects of comparison merely with those more immediately connected with our own subject.

The point of view to which we allude is that peculiar case, or instance of gravitating force, termed *weight*. In our illustration the attractive forces of matter above given we supposed a case in which one ball was very much larger than the other: now this precisely corresponds with the case of the globe of the Earth, and of all common bodies near its surface. The earth is more than 1,000,000,000,000,000 times the mass of any body which is observed to fall on its surface, and if even the largest body which can come under observation were to fall through a height of 500 feet, the corresponding motion of the Earth would be through a space less than the 1,000,000,000,000,000th part of 500 feet, which is less than the

100,000,000,000th part of an inch, and therefore quite inappreciable.* Now the attractive force exerted between the earth and detached bodies is denominated *weight*. Hence the weight of a body, at the earth's surface, is proportionate to its mass, or to the quantity of matter it may contain, whatever its form or qualities may be—a most important fact for the chemist, who, by employing the chemical properties of bodies as indications of identity or of change, is by these means enabled to apply to them the more certain measure of *weight*, and thus in some degree to bring them under the dominion of the laws of quantity.

CHAPTER III.

OF MOLECULAR OR POLARIZING FORCES, ETC.

IN all chemical operations, as already observed, we only witness the beginning and the end, the cause and the effect, while the whole of the intermediate changes elude our senses. Nevertheless, by a careful observation of the phenomena we are enabled to form some notion upon the subject, and that amply sufficient to convince us of their wonderful nature. With a view, therefore, of arresting the attention of those who may be unconscious of these wonders, or too apt to overlook them, we have thought it proper to premise a sketch of what may be supposed to take place among the ultimate particles of which all bodies are constituted, during those remarkable changes which they are constantly undergoing. And here it may be remarked, once for all, that many of the views commonly entertained on these points have always appeared to us to be so imperfect and unsatisfactory, that so far from elucidating the subject, they have only served to render it the more obscure. In the following sketch, therefore, as better adapted for our purpose, we have endeavoured to give that view of the subject, which, after twenty years of close attention and no ordinary labour, we have been induced to consider as the most simple and consistent with the phenomena. The general reader, who feels no interest in these inquiries, and who at the same time wishes to be apprized of the nature of the arguments deducible from the divisibility and molecular constitution of matter, is referred to the end of the present and of the following chapters for a summary of these arguments.

* Lardner's Cabinet Cyclopædia, Art. Mechanics, p. 79.

SECTION I.

Of the Divisibility of Matter.

THE first point which naturally claims our attention in the consideration of molecular operations, is the *size* of these molecules; a subject usually discussed under the head of the divisibility of matter. Matter, or rather space, may be conceived to be divisible *ad infinitum*; at least no limits can be assigned beyond which its subdivision cannot necessarily proceed. As, however, it exists in the world around us, there cannot be the least doubt that it is composed of ultimate particles or molecules incapable of further division or change, at least by ordinary agents: the reasons for these assertions will appear hereafter, at present it is our object to convey to the general reader some idea of the magnitude of these particles, with the view, principally, of showing how infinitely they surpass the limited powers not only of our senses, but almost of our conception. The subject, however, has so much attracted the attention of philosophers, that most of our readers must be already familiar with it; we shall therefore content ourselves with merely selecting a single instance from each of the kingdoms of nature. As an instance from the mineral kingdom, we may quote from Dr. Thomson, who has shown that an ultimate molecule of lead cannot weigh more than the $\frac{1}{310000000000}$ th, nor an ultimate molecule of sulphur more than $\frac{1}{201500000000}$ th of a grain, and probably a great deal less; and that the *size* of the molecule of lead cannot surpass, and is probably much less than the $\frac{1}{338492000000}$ th of a cubic inch!* The vegetable kingdom presents us with innumerable instances, not only of the extraordinary divisibility of matter, but of its activity, in the almost incredibly rapid development of cellular structure in certain plants. Thus the *Bovista giganteum* (a species of fungus,) has been known to acquire the size of a gourd in one night. Now supposing, with Professor Lindley, that the cellules of this plant are not less than the $\frac{1}{100}$ th of an inch in diameter, a plant of the above size will contain no less than 47,000,000,000 cellules; so that, supposing it to have grown in the course of twelve hours, its cellules must have been developed at the rate of nearly 4,000,000,000 per hour, or of more than sixty-six millions in a minute!† and when we consider that every one of these cellules must be composed of innumerable molecules, each one of which is again composed of others, we are perfectly overwhelmed with the minuteness and number of the parts employed in this single production of nature. But the animal kingdom perhaps presents us with still more striking instances than these.

* System of Inorganic Chemistry, I. 7.

† Introduction to Botany, page 7.

Thus animalcules have been discovered whose magnitude is such that a million of them does not exceed a grain of sand; and yet each of these creatures is composed of members as curiously organized as those of the largest species; they have life and spontaneous motion, and are endowed with feeling and instinct. In the liquids in which they live they are observed to move with astonishing speed and activity, nor are their motions blind and fortuitous, but evidently governed by choice and directed to an end. They use food and drink, from which they derive nutrition, and are therefore provided with a digestive apparatus. They have great muscular power, and are provided with limbs and muscles of strength and flexibility. They are susceptible of the same appetites, and obnoxious to the same passions. Must we not conclude that these creatures have hearts, arteries, veins, muscles, sinews, tendons, nerves, circulating fluids, and all the concomitant apparatus of a living organized body? and if so, how inconceivably minute must these parts be? If a globule of their blood bears the same proportion to their whole bulk, as a globule of our blood bears to our magnitude, what power of calculation can give an adequate notion of its minuteness?*

We have thus endeavoured to convey some idea of the magnitude of the ultimate molecules of which bodies are composed; but though we have succeeded in showing that they cannot exceed a certain magnitude, we are by no means certain that they are not in reality much less—indeed a great deal less than the least magnitude of which we have endeavoured above to convey a conception: yet notwithstanding this inapproachable minuteness, they retain all the characters of matter in the highest degree, and moreover possess certain remarkable properties in common, upon the nature of which, in the next place, we have to make a few remarks.

SECTION II.

Of the Forms of Aggregation of the ultimate Molecules of Matter.

MATTER in the aggregate, and as it appears to exist in the world around us, is known to us principally in three forms or conditions:—the *Solid*, the *Liquid*, and the *Gaseous* (the latter including the state of vapour and the etheriform conditions of matter); these in their well marked states are sufficiently distinct, though the whole gradually run into each other; the solid into the liquid, and the liquid into the gaseous, by such imperceptible grades, that in many instances it is not easy to say where one ends and the other begins.† The

* Lardner's Cyclopedia, Art. Mechanics, p. 13.

† It may be proper here to observe that some bodies, as water, for instance, are capable of existing in that perfectly gaseous form denominated *vapour*, under all ordinary circumstances; thus even ice gives off vapour rapidly, as we shall find hereafter.

notions, which the mechanician or natural philosopher employs in reasoning on these forms of bodies are—of a solid, that all its parts are indissolubly and unalterably connected, and impenetrable, so that the relative situation of the parts among one another, cannot be changed, or one part be set in motion without all the rest; of a liquid, that all its parts are freely moveable among one another, but that it is not dilatible or compressible by mechanical means; of a gas or aeriform body, that all its parts are not only freely moveable among one another, but that it is compressible and dilatible without limits. Strictly speaking, however, there are no objects in nature actually existing which completely conform to these definitions; no solid, for instance, absolutely hard and impenetrable, no fluid not compressible and dilatible, no gas compressible or dilatible without limits: and these circumstances are evidently the natural result of their being composed of aggregations of the minute molecules we have been considering. Thus solids composed of such molecules must necessarily have innumerable interstices or pores; hence when submitted to pressure, they are liable to undergo more or less of condensation, and apparently occupy less space than before: the same remarks may be made with respect to liquids; while gaseous bodies, supposed to be composed of such molecules, of course cannot be infinitely compressible.

SECTION III.

Of the Solid Form of Bodies. Crystallization.

NATURAL solids present us with a variety of properties usually termed *secondary*, many of which are of the utmost importance; such are *hardness* and *softness*, *elasticity*, *toughness*, *malleability*, *tenacity*, *ductility*, &c., all too well understood to require definition here. These properties evidently depend in a great degree upon original differences in the properties of the component molecules themselves; but there is no doubt that many of them are also intimately connected with the modes in which the molecules are arranged. Of these modes we can form no precise idea in a great many instances: there is, however, *one* form of solid aggregation, the *regular crystalline form*, which has occupied much more attention than the rest, and upon this we shall proceed to offer a few remarks.

As an object of illustration we shall select the familiar one of *water*, which from its well known properties of existing either as a solid, a liquid, a vapour, or a gas, by a slight variation of circumstances, is well adapted for our purpose, as we are thus enabled to employ the same object of illustration throughout. At present we have to consider it in its solid form of *ice*.

Every one must have remarked that water in the act of freezing

assumes various symmetrical forms, shooting into speculæ, &c., as may be beautifully seen on our windows on a frosty morning. Now this affords a familiar instance of what is termed *crystallization*, a property apparently possessed by all ponderable matter, and readily exhibited by it when under favourable circumstances: and it has been remarked that the form assumed by the same matter is usually similar, or easily deducible from some common form according to well ascertained and obvious laws. Let us now briefly inquire into the properties which the ultimate molecules of water must be supposed to possess to enable them to form these symmetrical aggregations. In the first place it is evident that the simple supposition of mutually attractive forces between these molecules, analogous or identical with the forces of gravitation, is inadequate to explain the phenomena. Possessed of such properties alone the ultimate molecules of bodies might indeed be imagined to adhere together, and their aggregations might even exhibit something like regularity, but this regularity would in a great measure be accidental, and probably never twice alike; hence the utmost latitude of assumption would never enable us to explain upon such principles alone that sameness of figure above alluded to as always assumed by the same matter. It is obvious, therefore, that the ultimate molecules of bodies are influenced by other powers than those of simple *inertia* and attraction: what is the nature of these powers? On this point there have been various opinions. Some have supposed the ultimate particles of bodies to possess shapes identical with those of the aggregates, which they form; that a crystal, for example, whose shape is a cube, is formed by the aggregation of a number of infinitely little cubes, &c. But to others this supposition has appeared so improbable, and so unlike the usual simplicity of nature's operations, that they have rejected it, and have formed the more feasible hypothesis, that the ultimate molecules of bodies are either spheres, or spheroidal, that is to say, more or less, *virtually* globular.* Let us take it for granted then that the ultimate molecules of bodies are spheres, with what powers is it necessary to suppose these little spheres to be invested in order to enable them to cohere and form the symmetrical figures we observe among natural bodies? The existence of simple, mutual, and general attractive powers among such a set of molecules, has been already observed to be inadequate to explain the phenomena; there must be some specific powers determining similar particles, to com-

* Strictly speaking, perhaps this observation is applicable to the forms supposed to be assumed by the influences surrounding the molecules, and by which all their operations are directed, rather than to the absolute forms of the molecules themselves, which, though in all instances virtually exerting spheroidal influences, must, in different instances, have very different forms. Those who wish to study the principles upon which spheroidal molecules may be supposed to aggregate into crystalline forms, are referred to Dr. Wollaston's interesting paper on the subject in the *Philos. Trans.* 1813, p. 51. It may be noticed, however, that the principles here advanced differ materially in other respects from those referred to.

bine in similar ways, otherwise the same resulting forms could not be supposed to take place. In the, three small spheres,* (Fig. 1.) let us suppose the points Ee, Ee, Ee , on their superficies to be endowed with the following properties, viz. that the similar points E, E, E , and e, e, e , have the property of mutually repelling each other, while the dissimilar Ee, Ee, Ee , have the property of mutual attraction. In such a case the three molecules will readily combine E to e , as in Fig. 2, but in no other way. Now let us suppose the same three spheres to be endowed with properties at the points Mm, Mm, Mm , as in Fig. 3, very similar to those at Ee . Spheres so endowed will aggregate readily, as in Fig. 4.

Fig. 1.



Fig. 2.



Fig. 3.

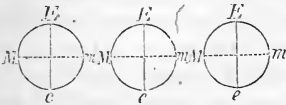


Fig. 4.

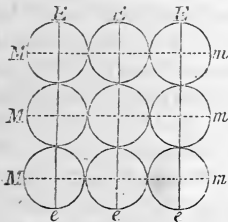
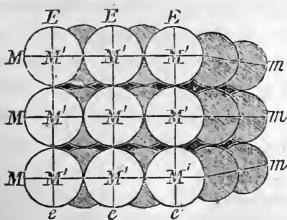


Fig. 5.



Fig. 6.



and thus instead of a single line we obtain a plate of molecules one in thickness.† To form the third dimension, or to constitute a solid, it is necessary to assume the molecules as in Fig. 5, to be possessed not only of the attractive points Ee, Ee, Ee, Mm, Mm, Mm , but also of $M'm', M'm', M'm'$, (the point m' , being supposed to be opposite to the point M , and out of sight.) Molecules so endowed will readily combine as in Fig. 6, and form a cube or some figure obviously deducible from it, but in no other manner; and in this way by assuming certain attractive and repulsive points upon our spheres at appropriate parts of their superficies, it is not difficult to conceive them capable, in different instances, of forming aggregates of any shape whatever. The next point to be considered is, how far are we authorised in making such apparently complicated and gratuitous assumptions respecting the properties of the ultimate molecules of matter;

* Or rather sections of spheres, and the same is to be understood of all the subsequent figures.

† Here it is to be observed that the similar poles E, E, e, e , of each pair of molecules being supposed to be repellent within certain limits, as will hereafter be explained, their absolute contact is prevented, and the two molecules are balanced,

are there any phenomena in nature justifying such conclusions, and what are they? And this leads us to inquire further, but as briefly as possible, into the phenomena of aggregation, as we see them constantly going on around us.

Aggregation is usually considered as of two distinct kinds, viz. that depending upon the simple cohesion of *similar* molecules of matter, as of water, and which for the present may be supposed to undergo no change by the combination; and that depending upon the union of *dissimilar* molecules of matter, capable of exerting a mutual *chemical* change upon each other, in which case the aggregate is a *tertium quid*, or third something differing altogether from either of the original molecules composing it. Now both these kinds of aggregation obviously exist in the same substance, at least when in the solid form. In the first place the chemical aggregation is exerted between the heterogeneous molecules, (hydrogen and oxygen in the present case of water) which uniting, form compound-homogeneous molecules, (of water); while in the next place, the molecules of water uniting *chemically* in one direction and *cohesively* in the other, form the solid crystal (of ice). Hence chemical aggregation and cohesive aggregation are as distinct as the polarities themselves upon which they depend; and if the one existed alone without the other, no such thing as a regular crystalline solid would probably be formed in nature.

From the above views, of molecular forces, it follows as a consequence that every molecule, and crystalline aggregate of molecules, must possess one axis (as that, for instance, joining the polarities *E e* in the preceding figures,) having totally different powers and properties from the other two axes and polarities. This axis, by way of distinction, may be called the *chemical* axis and polarities. The other two axes (and indeed every other axis that can be supposed to be drawn, through the centre, from opposite points of the superficies of the molecule) probably possess common properties, and may be called the *cohesive* axes and polarities. Here then the existence of two forces is indicated, the one axial, the other equatorial, if we may be allowed the expressions. The next question is, do such forces actually exist in nature on the large scale, and what are these forces? Now late observations have proved, beyond a doubt, that the *electric* and *magnetic* are such forces. We proceed, therefore, to take a short view of electricity and magnetism.*

as it were, between the two opposing and the two attracting forces. The consideration of forces operating in these and in the other modes, subsequently mentioned, present some highly interesting and novel objects of research for the mathematician.

* It may be remarked, that as all parts of the superficies of our molecules, except the *chemical* poles, are supposed to be more or less capable of cohesion, their aggregation in the form of common crystallized solids may be readily conceived. With respect to the cohesion, (if we may be allowed the expression) of the different chemical poles *E e*, of similar molecules with each other, such cohesion seems to be proved by several circumstances, which it would be foreign to our purpose at present to inquire into; but of which, perhaps, the optical properties of crystals will hereafter form one of the most striking illustrations.

Electricity.—It would be foreign to our present purpose, to enter into details respecting this or any other department of science we may have occasion to allude to: hence we shall content ourselves with a short summary of its general principles. It seems to be satisfactorily proved that the phenomena of electricity depend upon two energies, usually existing throughout nature in a state of equilibrium, in which state their peculiar powers are not perceptible; that this equilibrium is capable of being destroyed by a variety of causes, as friction, &c.; and that owing to the different capacities possessed by different bodies, for conducting and retaining them, these energies can be partially separated and kept asunder, in which state they are capable of exhibiting their peculiar powers. These powers are such, that if two bodies charged in excess with the same energy be brought into the vicinity of each other, they mutually repel each other; while two bodies charged with the two different energies mutually attract each other. In this disturbance of the equilibrium of the two energies, it is to be remarked, that in no instance do we suppose that the two energies are, or can be, entirely separated, so as to reside each, *per se*, in different bodies; but that a portion of the energy of the one body goes to the other body, which at the same time returns a corresponding portion of its antagonist energy; hence, other things being equal, each body contains the same total quantity of the two electricities as before the equilibrium was destroyed. For the sake of the general reader, the matter, in short, may be represented numerically as follows:—Let us suppose that 2000 balls, all exactly of the same size, &c., but one half black and the other half white, are divided into two equal groups, A and B, of 1000 balls each, but in such a way that the group A shall contain 200 black and 800 white balls, and the group B 800 black and 200 white balls. In this case the two groups will correspond exactly with two bodies in different states of electricity; and (supposing them to be possessed of similar powers), if a third group, C, containing 200 black and 800 white balls be brought into the neighbourhood of the group A, which is similarly constituted, the two will be found mutually to repel each other, till they approach within a certain distance, that is to say, till the 200 black balls of each group come into action, and unite each with 200 white balls. At this distance they will no longer repel but attract each other; although, instead of forming a state of equilibrium, the white balls (or one of the electric energies,) will predominate. The same thing precisely may be supposed to happen if a fourth group, D, composed of 800 black and 200 white balls, be brought into the neighbourhood of the group B. But if the group A, containing 200 black and 800 white be brought into the neighbourhood of the group B, containing 800 black and 200 white, the two will attract each other, and combine to form the original group of 2000 balls, consisting of 1000 of each kind, as at first supposed.

Such are, we believe, the fundamental laws of action and equilibrium of the two electric energies. There is one circumstance immediately arising out of them, which, as it is the most frequent and important of all the causes disturbing the natural equilibrium of the two energies in different bodies, we shall briefly explain: we allude to what are usually called the phenomena of *induction*. Suppose an electrified body A, (that is to say, a body having the equilibrium of its electric energies destroyed, as above mentioned,) be brought into the neighbourhood of another body, B, in its natural state, what takes place? The electricity E, of the body A, acting upon the corresponding electricity E, in the body B, repels it to the furthest extremity of the body B; and at the same time attracts to that end of the body B which is nearest to the body A, the other and opposite electricity e. The body B, therefore, while under the influence of the body A, will exhibit all the phenomena of electricity, and is said to be *electrified by induction*; but remove this body B from the neighbourhood of the body A, and immediately the natural equilibrium of the energies of the body B will be restored, and all signs of electricity will vanish. In this experiment neither of the bodies gains or loses anything. As these phenomena are constantly occurring in nature, and as we shall have frequent occasion to use the term *induction*, we have endeavoured to convey an idea of the nature of the subject to the general reader.

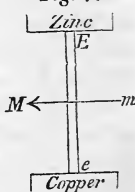
Of Galvanism.—While we are upon the subject of electricity, we may briefly notice that important modification of it termed *galvanism*. This form of electricity, instead of being evolved by friction, is usually obtained by the mutual action of various metals and chemical agents upon each other. Late experiments, however, have shown that the energies thus developed, differ in no respect from those of common electricity, but that they are obtained in this way in much greater *quantity* only, though in a lower state of *intensity* than by the common machine; and that many of the supposed peculiar effects of galvanism are the consequences of the *motion* of such large quantities of these energies, through bodies of various conducting powers. Galvanism has recently attracted much more attention than ordinary electricity, from the facility with which it may be applied to the purposes of the chemist, and from the extraordinary light it has thrown upon many chemical phenomena. Indeed, the chemist has been more indebted to the energies of galvanism than to any other; and he will probably be still further indebted to them than he yet has been. With respect to the phenomena of galvanism, these in most respects, so closely resemble the phenomena of electricity, that they do not require further illustration here.

Of Magnetism.—The general phenomena and laws of magnetism are very analogous to those of electricity. There are evidently two antagonist energies, which, while in a state of equilibrium, are not cognisable; but when separated, each one is mutually repellent of

its similar, and mutually attractive of its opposite or antagonist. Thus the two north or two south poles of two magnetic needles mutually repel each other (with the same exceptions as the two electric poles), but the north pole of one needle the south pole of another, mutually attract each other. Bodies are also rendered magnetic by induction when in the vicinity of another magnet, precisely as happens with respect to electricity. Magnetism principally differs from electricity in being apparently limited to a few bodies, as iron, and two or three others; but late observations have thrown an entirely new light on this part of the subject, which we have next to consider. Before we proceed, however, we may make a few remarks upon the obvious questions:—What becomes of the two electric and two magnetic energies when in a state of equilibrium? Do the electric and magnetic energies combine to yield the same, or a different result, and what is the nature of this result or results, and in what form do they exist around us? On these points different opinions have been held: some supposing that by their union, both the electric and the magnetic energies alike constitute *heat*; others something else. That both are most intimately connected with heat and light, is evident; but at present we decline to give a decided opinion on the subject.

We come now to consider the relations of electricity and of magnetism to one another—a discovery which we owe to Oersted, and one of the most important that has been made in the present age. The following is a summary of these relations. Let us suppose, in the annexed figure *E e*, to represent the wire connecting the zinc and the copper terminating plates of a galvanic battery in action. From what has been said, it may be conceived that under these circumstances there will be two currents *moving* through this wire in opposite directions; (from the copper to the zinc, usually called *positive* electricity, which may be supposed to be represented by our black balls in the previous illustration; and from the zinc to the copper, usually termed *negative* electricity, which may be represented by our white balls). Now in this state of things it has been satisfactorily established by experiment, that besides these two currents, there are two others having totally different properties, indeed all the properties of the magnetic energies, *moving*, not in the direction of the wire, but *in circles, or rather spirals, round it*. The energy corresponding to the north pole of the magnetic needle moves from right to left, round the wire, as above posited, while the energy corresponding to the south pole of the magnet moves in the opposite direction, or from left to right. Hence when a delicate magnetic needle *M m*, is placed *above* the wire *E e*, its north pole *M*, will be attracted by the current moving from left to right, with which it comes first in contact; and its south pole, for similar reasons, will be attracted by the opposite current.

Fig. 7.



A needle so placed will consequently assume the direction represented in the figure, with its north pole M to the left; and if it be carried round the wire by its point of suspension, it will be always found to keep the same relative position with respect to the wire. Thus, when *below* the wire, the needle will apparently point in the opposite direction; when on the same level, on the *left* hand, vertically downwards; when on the *right*, upwards.

Bearing in mind these relative positions of the currents and needles, in what follows we may neglect the currents and judge from the position of the needles alone. Let us consider the case of two connecting wires placed by the side of each other, as in the figures annexed, and which wires may be supposed to represent the chemical

Fig. 8.

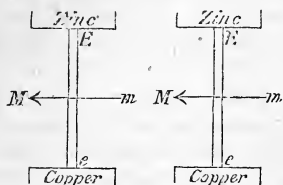
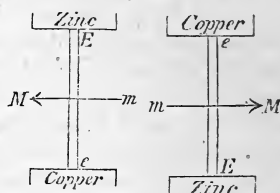


Fig. 9.



axis of our molecules. Now these wires, in consequence of the magnetic energies circulating round them, will mutually attract or repel each other, according to their position. If as in fig. 8, they are both in the same relative position, they will mutually attract each other, as may be inferred from the position of the needles, Mm , Mm , the north pole of one of which corresponds with the south pole of the other; but if one of the wires be reversed, as in fig. 9, they will mutually repel each other, the two similar poles of the needles in this case being contiguous. These relations hold universally, and what is most important, recent observations have shown them to be reciprocal; that is to say, if the magnetic energies be made to move in straight lines, the galvanic energies are found to circulate round them precisely in the way, and according to the laws above described as happening to magnetism round electricity. Hence electric sparks, and indeed all the phenomena of electricity can now be obtained from a common magnet.

Whether electricity and magnetism be different forms of the same energies resulting from the different directions of their motions—whether they be distinct energies—whether they be the cause or the effect of *Polarity*, we shall not stay to inquire; it is sufficient for our present purpose to know that they are inseparably associated with one another in the manner stated, and are always present at least in, if they be not the immediate cause of, all molecular actions among ponderable bodies. And this brings us back to the point, where we digressed to consider the subjects of electricity and magnetism.

We attempted to show that the ultimate molecules of matter must possess two kinds of Polarity; one which we have denominated *chemical* polarity, of a binary character, and existing between molecule and molecule, chiefly when of *different* kinds; and another denominated *cohesive* polarity, determining, under certain circumstances, molecules of the *same* matter to cohere. We further attempted to explain how these polarities (each supposed to be connected by its own proper axis) must exist or be distributed in our molecules so as to fulfil the offices assigned to them, and which they evidently fulfil in nature. Lastly, we have shown that the electric and magnetic polarities or energies are actually related to one another, precisely in the same way that we supposed the chemical and cohesive polarities to be. The question then at once arises,—are these forces identical? Do the electric polarities correspond with the supposed chemical polarities, and the magnetic with the cohesive polarities of our molecule?

To us, we have no hesitation in saying, this conclusion seems very probable, nay, almost inevitable, not only for the reasons stated, but for others equally striking, that we shall have occasion to refer to hereafter. In the mean time we may briefly consider the subject with a little more attention, and principally with reference to some apparent objections that may be raised against it. In the first place it may be objected that it is difficult from what we know of the varying and capricious character of the electric energies, to suppose that they can ever exist in that definite and permanent form in which they must exist if they be really identical with the cause of chemical affinity. To this objection, it may be replied, that magnetism can and does exist permanently in bodies for ages, and as electricity is an inseparable attendant upon magnetism, this energy must also have equal permanence. Again, a portion of zinc and a portion of copper placed in contact produce electrical effects as constant and enduring as the metals themselves. The argument, therefore, founded upon the want of permanence, and uniformity of the electric and magnetic energies, cannot, if duly considered, be supposed to have any weight; for the molecule may be conceived to be composed of two parts analogous to the copper and zinc in contact, and the electricity and accompanying magnetism evolved may be supposed to be as permanent in their character as the parts of the molecule evolving them. To the argument that electricity and magnetism, as we are acquainted with these energies, are *inadequate* to produce the effects and explain the phenomena of chemical affinity and cohesion, it may be replied, that they may be so: but that these energies, as we are acquainted with them, are probably merely accidental and peculiar modifications of the real energies, which in their elementary form, may be something altogether different, and quite unknown to us. In proof of this notion, it may be observed, that the electricities of the common machine and of the gal-

vanic machine apparently differ materially; while that existing in certain animals appears to differ from both. The magnetism evolved by electricity differs also slightly from common magnetism, yet no one now doubts that these differences arise from varieties in the quantity and intensity of the same energies, which in their elementary form, therefore, may, and probably do, differ from all these varieties. At any rate, we are unable to say that one of these varieties is more elementary than another, and consequently we have no right to assume that either of them is elementary, much less to found any argument upon the assumption.

Before we quit this subject of polarities and polarizing forces, it may not be amiss, in the last place, to make a few general remarks on the points in which they resemble or differ from those of gravitation.

The forces of gravitation, *inertia* and attraction, appear to be associated, and to reside in every individual *atom* of matter in the universe; hence every atom mutually attracts and is attracted by every other atom. The polarizing forces, on the other hand, are evidently disassociated, and reside in different parts of the same *mass*; hence this mass can in no instance be a mathematical point, (or atom?), but must consist of at least two parts; hence, also, as all matter appears to possess polarity, matter must exist in the state of mass or *molecule*, each of which molecules must occupy actual space. Thus the forces of gravitation and those of polarization are quite distinct. The forces of gravitation are primordial, and probably co-existent with matter; while the forces of polarization have more of a derivative or resultant character, and are evidently subordinate to those of gravitation. The question here naturally arises,—Are these different forces related to one another? Do the forces of polarization consist of the forces of gravitation in a state of separation, (if we may be allowed the expression,) or do they result from the motion of the molecules upon their axes? These are questions quite beyond our powers,—indeed we have nothing to do with them,—our present object being merely to point out the apparent limits within which the Deity has chosen to confine his operations.

SECTION IV.

Of the Liquid Form of Bodies. Of Heat.

HITHERTO we have spoken of the aggregation of molecules in the solid form only; we have next to consider their arrangement in that state in which they constitute a liquid. Our notion of a fluid, generally speaking, is, that all its parts or molecules, instead of being fixed, are perfectly moveable among one another; our notion of a liquid (the least perfect form of fluidity) is, that its molecules are incompressible. Now, still retaining water as our example of a

liquid, let us consider what must happen to its molecules situated, as we suppose them to be, in the form of ice, before they can be so arranged as to constitute the liquid water. A moment's reflection teaches us that they must be loosened or separated from each other; and, as they cannot separate themselves, that some new agency is requisite for the purpose. It need scarcely be mentioned that this agent is *heat*; on the general phenomena and laws of which most important principle we now proceed to make a few remarks.

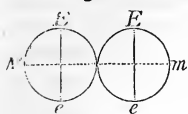
The sensations termed *heat* and *cold* are too well known to require explanation. These sensations, however, like all others, are merely the effects of some external cause or causes, operating on and through our organs, in a manner totally unknown to us. Various opinions have been entertained on the subject; some considering the cause of heat (caloric) to be an existent and material fluid, though of such extreme tenuity and imponderability as to escape our observation, and to become manifest to us only by its effects upon our sensations, and upon all the ponderable forms of matter; others considering it not as material, but as a property or principle of motion, which by exciting a certain species of vibration among the particles of bodies causes the sensations and effects of heat. Such are the most usual opinions, and the probability is, that they are neither of them literally correct, but that heat, and we may add light, are substances, the molecules of which are influenced by polarizing forces precisely similar in all respects to those which influence common matter; that is to say, that the molecules of heat and of light obey laws, similar in all respects to those which govern the molecules of ponderable bodies.* We have already alluded to the opinion maintained by some, that heat is a compound principle (like water for instance), consisting of a union of the two forms of electricity. We now draw the attention of the reader to this hypothesis, in order to state, that whatever heat may consist of besides, it is almost impossible to explain its effects upon the polarizing forces, without supposing that it at least involves, if it do not pass into the electric forces, upon which the polarizing forces *appear* to us to depend. We have said *appear*, for as has been already stated, though it is convenient to consider the polarizing forces under the forms of electricity and magnetism, in which they are most usually and palpably manifested to us among ponderable bodies, yet, in their elementary form these forces may in reality be something very different, not only from those of electricity and magnetism, but from all others with which we are acquainted; while electricity and

* We are aware that this opinion is opposed to that of most mathematicians, who favour the undulatory theory of light, and with good reason, so far as they have occasion to consider it; but we are decidedly of opinion that the *chemical* action of light can be explained only upon chemical principles, whatever these may be. Whether these chemical principles will hereafter explain what is now so happily illustrated by undulæ, time must determine.

magnetism, themselves, may be nothing more than the effects of these elementary forces upon the subtle matters of which the electric and magnetic molecules are composed.

One of the most general effects of heat is the increase of volume which it produces in all bodies in which it is accumulated. There are a few exceptions to this law, and one of so curious and important a character as to require especial notice hereafter. In the mean time, however, the generality of the law may be taken for granted, and an attentive comparison of what has preceded and follows, will perhaps throw some light upon the nature of this phenomenon.

Fig. 10.



Let us suppose Fig. 10, to represent, as in our former illustrations, two molecules of ice, with the chemical axes $E e, E e$, parallel and similar. In this state their cohesive polarities will be dissimilar, and the molecules, of course, will cohere as represented. Let us now suppose, from some external source, a certain quantity of heat to be communicated to these molecules. The natural tendency of heat is usually considered to be to arrange

Fig. 11.



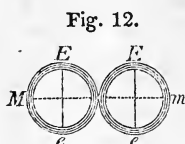
itself in the form of an atmosphere, around the molecules as in Fig. 11; the consequence of which is, that their apparent temperature is raised a certain quantity, and they will be separated from each other in some slight degree; they will thus occupy more space than in Fig. 10, before the addition of heat; the cohesion between the parts $M m$ will also at the same time be diminished. And here it may be proper to notice an important fact, that the same quantity of heat when introduced into different bodies produces very different *apparent* temperatures and effects, and that this constitutes what is called by chemists their *capacity for heat*, or their *specific heat*. Thus if the same quantity of heat, which we supposed to have been introduced into two molecules of ice, had been introduced into two molecules of silver, their apparent temperature would have been raised more than ten times as much as that of the molecules of ice; hence in the case of the ice some of the heat must have disappeared, or become, in the language of chemists, *latent*, a most important property of heat which we have next briefly to inquire into. Previously, however, it may not be amiss to observe, that the molecules of heat are supposed to be vastly less than those of any ponderable substance; and that they may thus, without any incongruity, be supposed capable of forming an atmosphere around the ponderable molecules, which they could not otherwise of course be imagined to do.

The *latency* of heat appears to depend upon two totally different phenomena, or rather, properly speaking, is of two distinct kinds, as may be thus illustrated. Let us take the two bodies above alluded to—ice and silver; these under the same volume contain very un-

equal portions of matter, the silver being ten times as heavy as the ice. The vacuities in the ice, therefore, must be very much greater than those in the silver; hence, when the same quantity of any principle, capable of occupying such vacuities, as heat may be supposed to be, is introduced equally into both, very dissimilar apparent effects must be produced. The more porous body will absorb and condense within its vacuities the added principle, and leave but little external and sensible; while the less porous body, having less room among its pores, will exhibit a larger quantity external and sensible. The more porous body, therefore, may be said to have a greater capacity for heat than the less porous body, from its greater power of absorbing heat, and rendering it latent.* This, we believe, is the usual explanation of the phenomenon under the assumed circumstances, and it is probably correct to a certain extent: but there is obviously another form of latent heat, totally different from the above, and which evidently cannot be explained on the same principles, and this we have now to consider. Let us suppose that into a mass of ice, cooled considerably below the freezing point, a uniform and regular flow of heat be determined from some external source; the temperature of the ice, of course, will gradually go on increasing till it rise up to the freezing point; it will then suddenly stop, and remain stationary till a quantity of heat, equal to 140 degrees of the thermometer, have flowed into the ice. The ice has now become water; but up to that point the water still retains the original temperature of the ice; after that point, however, if the heat continue to be applied, the water acquires apparent temperature as before. Now in this experiment a quantity of heat equal to 140 degrees of the thermometer has actually disappeared; but this disappearance cannot be explained in the same manner as that above mentioned; for the water, instead of being greater in volume, and consequently having greater vacuities than the ice from which it was formed, is actually less, and must therefore contain fewer vacuities. How then are the phenomena to be explained? We commenced our observations upon heat, by alluding to the hypothesis that this principle is capable of being decomposed into two energies, if not identical with, at least operating in the same way as those of electricity. In the above experiment, therefore, we consider that the 140 degrees of heat which have disappeared, are decomposed and converted into the two polarizing energies; and that these energies thus produced are superadded to the energies already existing attached to the molecules of water, and in this way in-

* This union of heat with ponderable bodies may, perhaps, be considered as analogous to the condensation of gaseous bodies by porous substances—a very remarkable set of phenomena, which deserve to be much more carefully studied than they have been. The absorption of light is probably of a similar nature; and the whole apparently depend upon chemical principles, and probably, if studied in connexion, would mutually illustrate each other.

crease their total quantity or intensity. The changes induced in the relative position of the molecules of water, by this increase of intensity in their energies, may be illustrated as follows:—Let Fig.



12, as before, represent the position of two molecules in the state of ice. Here the similar poles $E E$ and $e e$, are of course mutually repellent, while cohesion takes place between the dissimilar polarities, as shown in the figure. Now suppose the polarities, $E E$, $e e$, to be suddenly much increased in intensity, so as to extend beyond the semi-diameter of the sphere; they will of course repel each other, and in such a way that the two spheres will revolve on the common axis of adhesion $M m$, and the axes $E e$, $E e$, instead of remaining parallel, will become at right angles to each other, as in Fig. 13; or rather as in



Fig. 14. In Fig. 14, a view is supposed in the direction of the common axes, $M m M m$, of Fig. 13, in which view, of course, $E e$, $E e$, are supposed to represent the chemical axes of the two spheres at right angles to each other. Hence in the liquid state of bodies the position of the axes of adjoining molecules may be supposed to be at right angles, or in some position less than right angles and approaching parallelism. At exact right angles the cohesive polarities are balanced and neutralized, so that the points $M m$ have neither a tendency to unite nor to separate, but remain simply in contact. Hence the molecules of such a body will be all disassociated and free to move among one another; and if we suppose each molecule at the same time to be surrounded by its atmosphere of caloric, so thin as not altogether to remove mechanically the molecules beyond one another's influence, we have probably as clear an idea of the nature of a liquid as we are capable of forming.

SECTION V.

Of the Third or Gaseous Form of Bodies.

WE have next to consider the most perfect form of fluidity, that of gas, or (adhering to our former example,) steam; and we shall, in the first place, take a short view of the molecular arrangement of bodies existing in the gaseous form, which will enable us still further to elucidate the subject of latent heat.

Let us suppose as before, the same constant stream of heat to be flowing into a portion of water that we supposed to be flowing into the ice: the water continues to increase in temperature and capacity for heat till it arrives at the boiling point; at this moment the tem-

perature ceases to be augmented, however much we may urge the application of heat, and the water is converted into a transparent gas, well known by the name of steam; to effect this latter purpose, however, under the ordinary circumstances of atmospheric pressure, it has been found that nearly 1000 degrees of heat are necessary, which large quantity of heat actually becomes latent or disappears, since the temperature of the steam formed never exceeds 212° , that of the water at the boiling point. What becomes of these 1000 degrees of heat? We may suppose one portion of it to become latent in the first two ways described above; that is to say the water in the act of being converted into vapour, is much augmented in volume, and into this augmented volume, as into a sort of vacuum, a portion of the heat may be supposed to rush and become insensible; but another portion of heat is obviously decomposed, and goes to augment the molecular polarities of the water, which in the case of steam (and in all gases,) may be imagined to be arranged in some such way as the following:—

In Fig. 15, we have represented as before, though in a different manner, the chemical axes at right angles to each other; at which angle the cohesive polarities are balanced and neutralized. This angle, therefore, may be considered as the point at which liquidity terminates and perfect fluidity begins. The next augmentation of heat increases the chemical polaric intensities still further, so as to induce them to repel (or rather to attract) each other's axes into the parallel position,

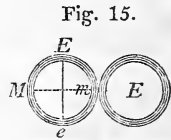
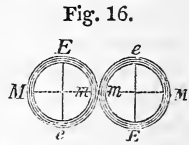


Fig. 16; where the chemical polarities are quite reversed, and of course, the contiguous cohesive polarities m and m are brought into the maximum state of repulsion. Now such a position, or some angle greater than a right angle, may be supposed to be that assumed by the chemical axes of the

molecules of all bodies when in the gaseous state. Hence, as there are two kinds of attraction, so there must likewise be two kinds of repulsion, viz. heterogeneous or chemical repulsion; and homogeneous, or self-repulsion, opposed to cohesion, upon which the gaseous form of bodies principally depends.



But here a question arises: in what state are the molecules of bodies in the condition of vapour, as those of water at all temperatures below 212° ; for instance at 32° ? According to an hypothesis to be presently mentioned, a given volume of steam, at 212° , contains the same number of self-repulsive molecules as a similar volume of air under the same temperature and pressure, and therefore has the same elasticity. But the elasticity of the vapour of water at 32° is only equal to about 1-5th of an inch of mercury;* hence the

* The elastic force of vapours increases with their temperatures; that is to say, according to our hypothesis, increases with the angle formed by the chemical axes

same given volume of that vapour at 32° will only weigh about 1-150th of what steam ought to weigh, supposing it could exist as a permanent gas at 32° , and under a pressure of thirty inches of mercury. The molecules of the vapour, consequently, will be five or six times further apart than in perfectly gaseous bodies under a similar temperature and pressure.*

Let us now, in the last place, inquire how the above suppositions respecting gaseous bodies accord with their common leading properties, viz., with their self-repulsive or diffusive properties; their equable expansion by heat; their increase in volume in the inverse proportion of the force with which they are compressed; and with their similar capacities for heat.

Of the diffusion of Gaseous Bodies.—For the facts connected with this most important subject we are principally indebted to Dr. Dalton and to Mr. Graham; the latter of whom has shown that when any gas or air is confined in a vessel furnished with a very narrow aperture or with a porous plug, an interchange between the confined and the external airs immediately begins to take place through the communicating aperture; and that this interchange continues to go on to a certain point, which, with respect to the same gas, appears to be uniform, but differs in different gases according to a certain law. Two gases also, whatever may be their specific gravities, and however they may be introduced into the same vessel, speedily become mixed uniformly throughout. These facts evidently indicate a species of self-repulsive influence among the molecules of the *same* gas, which appears to be satisfactorily accounted for by our hypothesis. The argument is very simple and obvious: Two molecules of the *same* matter have a tendency to cohere and to form a solid, when the chemical polarities of these molecules are similarly arranged, and do not extend beyond the semi-diameters of the molecules; but two molecules of *different* matter, under circumstances precisely alike, remain passive, and have no tendency to cohere. Hence, while two molecules of the same matter, having the intensity of their polarities much increased, and their chemical poles, consequently, reversed, repel each other, or become *self-repulsive*; two molecules of different matter, still retaining their mutual passiveness, do *not* repel each other.

of their molecules. At exact right angles the elastic force is 0; at 180° it is equal to that of air under similar pressure and temperature. Hence all intermediate elasticities lie between these two points.

* Supposing it were possible for steam to exist at 32° , of course at this temperature its weight would bear to that of air, the same proportion it bears at 212° , that is to say, as 5 to 8. Hence 100 cubic inches of steam at 32° , ought to weigh 20.49375 grains; or 5-8ths of 32.79 grains, which is the weight of 100 cubic inches of air at 32° . But the weight of 100 cubic inches of steam at 32° is only .1366 grain, or 1-150th that of air. The number of molecules, in steam at 32° is consequently only 1-150th of those in air at 32° . Hence this diminution of the number of molecules, if we suppose them to be diffused equally throughout the same space of 100 cubic inches, must of course, as stated in the text, cause them to be between five and six times further apart.

There is reason to believe that these phenomena are not confined to bodies perfectly gaseous, but exist also in that less perfect gaseous condition termed *vapour*, of which the vapour of water may be considered as the most familiar example. On this supposition, and particularly that the above law of diffusion holds among vapours, (which is probably the case, though in a modified form) the lower the specific gravity of the vapour, that is to say the lower the temperature, the greater the diffusive power; and consequently the more rapid the evaporation: a most important inference that will enable us to explain many meteorological phenomena, at present quite inexplicable. Something very similar, if not identical with the above phenomena, also exists in liquids and perhaps in solids. Thus the molecules of certain matters diffused through a liquid, as water, may be supposed to exert in some cases a self-repulsive influence on each other, by which supposition only do their equal diffusion through a large mass of liquid seem explicable. Even in the solid state, as above observed, something of the kind appears to exist, especially among organized bodies, which apparently owe some of their most remarkable properties to the diffusion of active self-repulsive molecules throughout their substance.

Of the equal Expansion of Gaseous Bodies by Heat.—With respect to the second important property of gaseous bodies, that under the same temperature and pressure they all undergo equal expansion by an equal increase of heat; this seems to be explicable only on the supposition that *all gaseous bodies, under the same pressure and temperature, contain equal numbers of self-repulsive molecules*: a most important conclusion, as we shall see hereafter, and one, which at present we are anxious a little further to illustrate. Supposing the fact to be, as it is, undeniable, that within the ordinary limits of experiment, all perfectly gaseous bodies expand equally by similar increments of heat, *if* different gases contain *unequal* numbers of self-repulsive molecules, those gases which contain the least number of molecules, must exert the greatest power, and consequently have the greatest disposition to expand; in other words, the expansive power of the molecules of a gas, must increase as their number diminishes; and not only so, but in order to produce the effect stated, the expansive power must increase, neither more nor less, but exactly as the number diminishes—a law which when applied to extreme cases becomes obviously absurd. Further it may be observed, in corroboration of the hypothesis advanced, that in the gaseous state the molecules of bodies may be considered as having undergone the utmost effects, that any increase of heat can produce upon them. All their interstitial vacuities may be supposed to be already saturated with it; while an atmosphere may be supposed to surround each molecule, keeping them individually at a considerable distance from each other: their polarities also may be supposed to have undergone their ultimate change, so that no more heat can be rendered latent by in-

ducing further changes, except in degree, which degree may be supposed to be common to all gases. Hence every molecule of matter, when in the gaseous state, and subjected to similar pressure and temperature, may, without reference to its other properties, be supposed to be in circumstances exactly similar, and consequently liable to be affected in an exactly similar manner by all further increments of heat.

Of the inverse Relation of the Volume to the Compressive Force.—Nearly the same remarks apply to this law as to the preceding; for were the numbers of molecules in each gas supposed to be *unequal*, the diminution of volume under similar pressure ought to vary also, which is not the case, at least in the more perfect gaseous bodies, and neither this observation, nor those in the former paragraph apply to vapours.

Of the similar capacity of Gaseous Bodies for Heat.—The best experiments seem to show that under the same pressure the same volumes of all gases have the same capacity for heat—a circumstance quite according with the other phenomena. Hence, for the above and other reasons which might be mentioned, we have been induced to adopt the hypothesis already stated, that, *under the same pressure and temperature, all bodies in a perfectly gaseous state contain equal numbers of self-repulsive molecules.**

SECTION VI.

Other properties of Heat. Of Heat in Motion.

HEAT appears to be in a constant state of motion and of interchange between different bodies, among which it finally settles into a state of equilibrium. If accumulated in any body, this accumulation cannot be preserved; but the excess will fly on in spite of all we can do to the contrary, and sooner or later the equilibrium will be restored. This motion of heat takes place in three ways, which a common fire-place very well illustrates. If, for instance, we place a thermometer directly before a fire, it soon begins to rise, indicating an increase of temperature. In this case the heat has made its way through the space between the fire and the thermometer, by the pro-

* It is proper to observe that these views were adopted by the author long before he was aware of the existence of the essays on the subject by Messrs. Avogadro, Ampere, and Dumas. Indeed he was unacquainted with those of Dumas, which most nearly resemble his own, till he saw them alluded to in Mr. Johnson's recent report on chemistry in the 'Transactions of the British Association. Mr. Donovan seems to consider the above hypothesis as untenable; but we think his arguments entirely inconclusive. See *Giornale di Fisica*, sec. 11. tom. viii. p. 1.; *Annales de Chimie*, tom. xc. p. 43; a *Treatise on Chemistry*, by Mr. Donovan, in *Lardner's Cabinet Cyclopædia*, p. 379; and the Introduction to Dumas's *Traité de Chimie appliquée aux Arts*, which excellent work the author had been prevented from perusing by the nature of the title.

cess termed *radiation*. If we place a second thermometer in contact with any part of the grate, and away from the direct influence of the fire, we shall find that this thermometer also denotes an increase of temperature; but here the heat must have travelled through the metal of the grate, by what is termed *conduction*. Lastly, a third thermometer placed in the chimney, away from the direct influence of the fire, will also indicate a considerable increase of temperature; in this case a portion of the air, passing through and near the fire, has become heated, and has *carried* up the chimney the temperature acquired from the fire. There is at present no single term in our language employed to denote this third mode of the propagation of heat; but we venture to propose for that purpose, the term *convection*,* which not only expresses the leading fact, but also accords very well with the two other terms. Each of these modes of the propagation of heat possesses certain peculiarities, on which we proceed to make a few remarks.

Radiation of Heat.—Heat radiates in *vacuo* in all directions equally, and with unmeasurable velocity. Heat radiates also through all gaseous bodies, and more or less through transparent media. Radiation goes on at all temperatures; but the quantity of heat radiated in a given time bears some proportion to the excess of the temperature of the radiating body above that of the surrounding medium. Radiant heat is capable of being *reflected* like light, (to be presently noticed,) and, indeed, obeys altogether somewhat similar laws. Those surfaces however, that reflect light most perfectly, are not equally adapted to the reflection of heat. Metals in general, and particularly when highly polished, are the best reflectors of heat, while glass, which reflects light most perfectly, reflects comparatively little heat; thus tin-plate reflects about eight times as much heat as a glass mirror. The radiation of heat is much influenced by the nature and state of the surfaces of bodies. Thus a surface coated with lamp-black radiates eight or nine times as much heat as a polished surface of tin or silver; and in general polished surfaces, particularly of metal, radiate much less than other surfaces. As might be expected, this difference of radiating power exerts great influence in the cooling of bodies; thus warm water retains its heat much longer in a bright tin vessel, than in the same vessel coated with linen, paint, or particularly lamp-black. Radiant heat is *absorbed* with different facilities by different surfaces. The absorbing power of surfaces seems, indeed, to vary directly as their radiating power, and inversely as their reflecting power. That is to say, surfaces receive heat by radiation nearly with the same degree of facility as they give it off; while those that reflect most, of course, must absorb least; a surface covered with lamp-black, for example, receives in a given time eight or nine times as much heat by radiation as a po-

* *Convectio*, a carrying or conveying.

lished tin surface receives. From these remarks, it will be readily inferred, that the colours of bodies may have considerable influence in the radiation and absorption of heat; now this is found to be the case, and the darker the colour of a body, the more readily it gives off, and absorbs radiant heat. Radiant heat has the power of passing through transparent bodies, as glass. This power, however, varies accordingly to the thickness of the glass, its relative position to the radiating body, and a variety of other circumstances not well understood; but generally speaking heat seems to obey laws, more or less, analogous to those of light under similar circumstances.

Conduction of Heat.—The conduction of heat is chiefly confined to solid bodies; and as solids exist of every degree of consistency and density, from perfect fluidity up to perfect hardness, the conducting power varies in like manner. Hence the laws of conduction and those of radiation have a mutual dependence; and, in fact, the laws of conduction may be considered as only extreme cases of the laws of radiation. The conduction of heat through bodies seems to take place equally in all directions. In general the densest bodies, as metals, stones, hard woods, &c., have the greatest conducting power, though these differ exceedingly among one another. Porous bodies in general are bad conductors; and of such bodies charcoal may be considered as one of the worst conductors. Among substances employed as articles of dress, hare's fur and eider down are the worst conductors, and flax the best. The relative conducting powers of substances of this class seem to depend much upon the quantity of air inclosed within their interstices, and the power of attraction by which this air is retained or confined. The conducting power of liquids and of gases is very limited, though under certain circumstances they *appear* to possess this power in a high degree. But this power is only *apparent*, and heat is chiefly communicated through liquids, and also through gases by the third process above alluded to, *viz. convection*. By convection however, heat is only propagated in one direction, namely, *upwards*; hence almost any degree of heat may be applied to the upper surface of a liquid or gas without affecting the lower.

Such are the principal phenomena connected with the motion of heat; but before we proceed to speak of the sources of this wonderful agent, we have yet to consider another imponderable principle of the utmost importance, and intimately connected with heat; *viz., Light.*

SECTION VII.

Of Light.

THE laws of the motion of light, of its reflection, refraction, polarization, &c., properly belonging to another department; we shall therefore, only briefly describe them here, and endeavour to point out the general connexion and analogy they bear to the phenomena of chemistry, and more especially to the phenomena of heat and electricity.

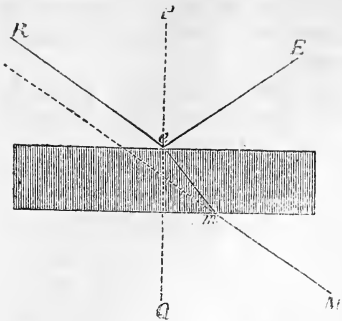
Radiation or Motion of Light.—Light radiates or moves in straight lines with such inconceivable velocity, that it occupies only about eight minutes in travelling from the sun to our earth, so that it must move at the rate of nearly 200,000 miles in a second! At the same rate it would occupy about four hours to travel to us from the planet Uranus, the present *ultima Thule* of our system; hence if this planet were at any given instant suddenly annihilated, we should not miss it for four hours afterwards; and when we look at it, we do not see it where it actually is at this instant, but where it was four hours previously. A cannon ball, when first shot from the cannon, moves with a velocity of between 2000 and 3000 feet per second; supposing, therefore, it could retain its initial velocity it would scarcely move in a year as much as light moves in a single second! The utmost velocities of the earth and other planets, in their orbits or on their axes, scarcely exceed 30 or 40 miles in a second. Hence the utmost velocity that we are acquainted with as possessed by ordinary matter, and therefore the utmost perhaps of which such matter is capable, only amounts to the 1-5000th or 1-6000th of that of light! These striking facts are mentioned with the view of conveying some notion of the immensity of space, and of the wonderful velocity with which it is in every direction penetrated by light. They seem also to show, that if light be matter, it must exist in a state of tenuity, totally different from the ponderable matter we are acquainted with, which actually seems incapable of such velocity.*

If we consider heat and light to consist of polarized molecules in the self-repulsive state, and to obey the same laws that ponderable matters in the gaseous state obey, which is exceedingly probable; the radiation of these imponderable bodies will be analogous to the diffusion of gaseous bodies, and by knowing their velocity and applying the same law, we may deduce their comparative gravities.

Reflection and Refraction of Light.—In free space as before observed, light moves in straight lines; but when a ray, *R*, Fig. 17, falls upon a polished surface, as of glass, a portion of it is reflected in the

* Pouillet, Elemens de Physique et de Meteorologie, tom. iii. p. 216.

Fig. 17.



ndergone *refraction*; a term indicating that its natural course has been broken. Such are the general facts; and the study of their laws, varieties, and peculiarities, as modified by different media, constitutes the science of optics, a branch of knowledge not falling within our present design. In connexion with this part of our subject, it only remains to observe, that in passing through the most transparent bodies much light is lost, by absorption and in other ways. So also when light falls upon metallic bodies, such as polished silver, about one-half only is reflected, while the other half is absorbed and lost. Different substances, however, differ materially in these respects, and from the experiments of M. Bouguer and M. Lambert, it appears that in fluids, transparent solids and metals, the quantity of light reflected, *increases* with the angle of incidence reckoned from the perpendicular; whereas in white opaque bodies the quantity of light reflected *decreases* with the angle of incidence.* We shall hereafter have occasion to revert to these curious facts.

Polarization of Light.—The next property we have to notice is what is called the *polarization* of light. Let us suppose Fig. 18.

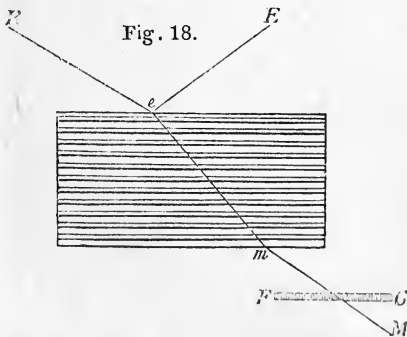


Fig. 18.

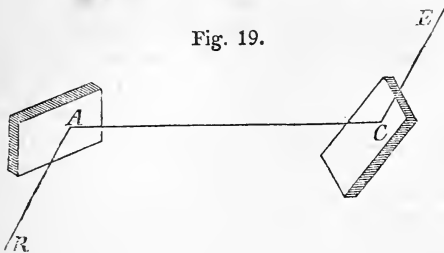
to represent a bundle of plates of thin window-glass, bound together in the manner indicated. Let $R e$ be a ray of light falling on the upper plate, at an angle of incidence of about 56° ; a portion of the ray will be reflected, and will move in the direction $e E$, while another portion of the ray $e m$, will pass through the

bundle of glass plates onwards to M , according to the laws of

* See article Optics, p. 67, and 68, in the Library of Useful Knowledge. Where the original observations are to be found, which are there referred to, we do not at present know.

reflection and refraction already stated. Now these two rays $e E$, and $m M$, possess remarkable properties, similar to one another in most respects, but directly opposed in another. Of these properties we shall endeavour to give a general idea.

If the ray of light $R A$, after falling upon the vertical glass A , Fig. 19, at an angle of incidence of 56° , be received on a plate of

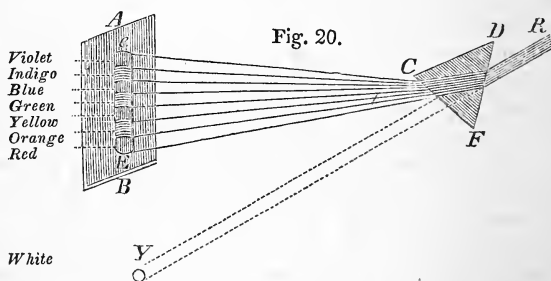


glass, C , placed at the same angle of incidence, and be then reflected from C to E ; in the position intended to be shown in the figure, when the ray R is first reflected in a horizontal plane, $R A C$, and then in a vertical plane, $A C E$, the ray $C E$ becomes so weak as to be scarcely visible, the whole of it having passed through the glass C . But if the glass C be turned round 90° , (the ray $A C$ being supposed to be the axis of motion) so that the ray $C E$ be reflected horizontally; instead of passing through the glass C as before, the whole of the ray $C E$ will be reflected. If we continue to turn the plate C upon the axis $A C$, round the entire circle, these alternations of transmission and reflection will be found to take place in the same manner at the two other quadrants 180° and 270° . Hence the ray $R A$, by reflection, has acquired properties altogether new; it is said in short, to have acquired *polarity*, or to have become *polarized*. Now recurring to Fig. 18, the ray $R e$, in that figure will of course follow the same laws as the ray $R A$ in Fig. 19, that is to say, the ray $e E$ will have acquired polarity by reflection. Let us now consider what has happened to the refracted ray $m M$ in the same Fig. 18. This ray $m M$ will also be found to be polarized; but if we receive it on a glass plate, $F G$, at the polarizing angle of 56° , we shall find that it will refuse to be reflected; whereas the reflected ray $e E$ does not refuse to be again reflected, unless the plate $F G$ be turned round 90° , or into a plane at right angles to that plane in which the refracted ray $m M$ had refused to be reflected. Hence we conclude that when a ray of light is incident at the polarizing angle upon a transparent body, the whole of the reflected light is polarized; while the whole of the transmitted light is also polarized, but *in a plane at right angles* to that in which the reflected ray is polarized.

Such is the general law, and it may not be amiss to allude briefly

to another familiar illustration of it. Every one is acquainted with the mineral called Iceland spar, and with the singular property which this mineral possesses of forming a double image of objects seen through it, or its property of double refraction; that is to say when a ray of light falls on a crystal of such spar in a particular direction, the ray is separated into two. Now it is a remarkable fact that if these two rays be examined in the way before directed, when speaking of reflected and transmitted light, it will be found that both are polarized, but that the two rays are polarized in planes *at right angles to each other*; that is to say, the ordinary transmitted ray is polarized like the ordinary ray transmitted, through the bundle of glass plates; while the extraordinary transmitted ray is polarized like the ray reflected from these plates. Many bodies are similarly constituted; while others have two or more planes or axes of double refraction, giving origin to a variety of curious and beautiful properties, which it would be quite foreign to our present purpose to detail further.

Decomposition of Light.—When a ray of light, *R*, Fig. 20, traverses a prism, *C D F*, instead of passing onward in the direction



Y, is refracted into the spectrum *E e*; which spectrum when received upon the screen, *A B*, will be found to consist of seven different colours, in the order and of the kind described, each having, of course, different refractive powers; the red being the least, and the violet the most refracted from the original direction *R Y*, of the solar beam. This oblong image is called the *solar*, or sometimes, the *prismatic spectrum*, and Sir Isaac Newton found that each colour consists of light no longer separable, like white light, into others, but having uniform refractive properties: hence he called all the seven colours simple or homogeneous, in opposition to white light, which he called compound or heterogeneous.* This important fact presents a clue to, and exhibits the general law which regulates the

* Sir David Brewster has lately shown that there are, in fact, but three simple colours, the *red*, the *yellow* and the *blue*, and that each of these colours exists throughout the spectrum. Hence, probably, like the different electric and magnetic energies, these elementary colours, or, at least, the *red* and the *blue* (the *yellow* being probably merely resultant), can never be entirely separated from each other.

endless variety and change of colours; as bodies appear to have this or that colour, according as they have the power of reflecting or transmitting this or that colour, and of absorbing or reflecting the rest; while white bodies reflect all, and black absorb all. Besides colour, it has been likewise noticed that different portions of the prismatic spectrum possesses different *heating* and *chemical* or *electrical* properties. These vary in some respects, according to the nature of the prism employed. In general the heating power increases towards the red ray; while the chemical power seems to be regulated in some degree by the nature of the colour, but is greater (though of opposite character) at the two extremities than in the centre of the spectrum, where it appears to be nearly null. The chemical properties of light, however, are by no means well understood, and have not received the attention which they merit.

Upon an attentive consideration of the phenomena of heat and of light, and a careful comparison of them with the general phenomena of polarizing forces, it is impossible not to be struck with the close analogy that prevails throughout the whole. The phenomena of heat have hitherto been very imperfectly studied, and in consequence we are much less able to trace the analogy; but the phenomena of light from their obvious and striking characters have attracted more attention, are much better understood. To enter further upon the inquiry here would be quite foreign to the object of this treatise; we cannot however, in concluding these remarks, refrain from repeating an opinion already expressed, that the molecules both of heat and of light possess polarities precisely similar to those of ponderable bodies; and that not only the chemical agencies of those principles, but those phenomena of light also at present so beautifully illustrated by the hypothesis of undulæ, will be hereafter found to admit of explanation on the more probable supposition of molecular polarity.*

* In the Newtonian hypothesis of *fits of easy transmission and of easy reflection*, the molecules of light may be regarded as little magnets revolving rapidly round their centres while they advance in their course, and thus presenting alternately their attractive and repulsive poles. (See Discourse on the Study of Natural Philosophy, by Sir J. Herschel, p. 253.) In our hypothesis, the chemical poles of all self-repulsive molecules are supposed to be arranged positive and negative alternately, (see Fig. 16, page 39;) by which arrangement the contiguous cohesive polarities are rendered of the *same* kind, and consequently repulsive. Hence when a series of self-repulsive molecules move onwards in virtue of their self-repulsive powers, (as in the radiation of light, &c.) the cohesive axes of the molecules will always be in the line of motion, and each successive molecule will present alternately an opposite polarity; while the chemical axes of course will be all in the same plane, and transverse to the line of motion. Such will be the order in a single series of molecules in motion; but when a number of series move onward together, as in homogeneous light, there is reason to conclude that the molecules of contiguous series have a tendency to arrange themselves thus with the chemical axes at right angles to each other. Those who are interested in these subjects will perhaps readily conceive how such arrangements may be applied to explain the various phenomena we have been considering.

SECTION VIII.

Of the Sources of Heat and Light.

THE principal and obvious sources of heat and light are the sun, electricity, mechanical action; change of physical condition, change of chemical condition; and organic action.

The sun is the most obvious and unvarying source from which both heat and light are communicated to our earth. The nature of the sun, however, and the mode in which that wonderful supply of heat and light is maintained are quite unknown to us, and will probably always remain so. Electricity is another source of heat and light which are developed at the moment of the equilibrium of the two energies; and some of the most intense degrees of heat and light that have been produced have sprung from a galvanic apparatus. The sudden condensation of air is likewise a source from which heat and light are often both extricated, on principles that it will not perhaps be difficult to understand from what has been stated. The extrication of heat by percussion and condensation appears to be limited, but its extrication by friction seems to be boundless; that is to say, so long as friction is kept up, will heat continue to be extricated, but whence the heat is derived does not appear to be capable of satisfactory explanation, unless we suppose a perpetual decomposition and recomposition to take place, which is not improbable. Another fertile source from which heat is derived, is the physical change of condition which bodies are constantly undergoing in nature, as for example, the conversion of gases into liquids, of liquids into solids, &c. by taking advantage of which conversions we can accumulate heat at will, as for instance by the condensation of steam. When these physical changes however are associated with chemical changes, as is very often the case, the most striking effects are produced. Of this kind are all the phenomena of combustion, the most common source of artificial heat; and which consists of nothing more than the rapid chemical union of certain bodies with others, and generally with the principle termed *oxygen*. Nearly allied to chemical action, and perhaps identical with it, is the extrication of heat by organic changes, or what is termed *animal* heat; a subject we shall have to consider in a future part of this volume.

WE have thus endeavoured to give a summary view of the phenomena, and laws of motion of heat, and of light. In conclusion it

only remains to observe that these phenomena and laws are all of the utmost importance in the economy of nature, as constituting limitations and principles of action, to which the Great Author of nature most rigidly adheres in his operations. Hence, whether we view the distribution of heat and of light on the large scale, as regulating climate; or whether we view them with reference to the most trifling particular, as the clothing of a bud or of an insect; we find the beautiful adaptation and contrivance, everywhere exemplified, to ensure or to evade the agency of these all-important principles. The wonderful arrangements connected with heat and light will however fall more naturally to be considered hereafter; we shall therefore defer what we have to say on these subjects till we come to speak of meteorology.

SECTION IX.

Recapitulation and General Observations on the Subjects treated of in the preceding chapters.

IN the preceding observations we have endeavoured to give a connected sketch of the nature and operation of molecular forces; and perhaps it will still further facilitate the understanding of the subject, if we recapitulate briefly the leading facts, so as to point out those who may not be inclined to peruse the foregoing details, the analogy that prevails throughout the whole.

1. In the first place we attempted to show that the forces which determine molecular union can scarcely be those of mere gravitation, in their ordinary forms at least; but that some other modification of force is necessary to account for the phenomena.

2. By assuming the molecules of bodies to be virtually spheroidal, and endowed with two kinds of polarizing forces, the one operating *axially*, and the other *equatorially*, we attempted to show how the phenomena of simple crystallization might be explained; and we corroborated our argument by demonstrating that the electric and magnetic forces are actually related to each other, precisely as we assumed the energies of our molecules to be. Hence we ventured to draw the conclusion, that electricity and magnetism, if not identical with, at least represent, or are analogous to those forces, the existence of which among ponderable bodies we assumed as necessary to account for the phenomena of crystallization. Further we attempted to render it probable, that the molecules of the imponderable princip'es, heat and light, possess polarities precisely analogous to those of ponderable bodies, and that many of their peculiar phenomena depend upon these polarities.

3. In attempting to account for the different forms assumed by bodies, we suppose that in the *solid* form, the molecules are so arranged as to attract each other according to certain laws; that in

the *liquid* form, they are so arranged as neither to attract nor repel each other; and that in the *gaseous* form, the arrangement of the energies of the molecules is such as to render them mutually repulsive. Further, by assuming that those molecules which possess the property of attracting each other in the solid form in preference to others, retain a similar relation in the gaseous form, and repel each other in preference to others, we attempted to account for many of the well known phenomena of gaseous bodies.

4. Lastly, we attempted to show that the phenomena of *radiation* among the molecules of imponderable bodies, are precisely analogous to the phenomena of diffusion and mixture among the molecules of ponderable bodies when in the liquid and gaseous states; and that consequently the same laws are strictly applicable to both.

With respect to the reasons which have induced us thus to enter into the dry details of molecular action, and which may seem to require some apology to our readers, they are chiefly two-fold: In the first place, as connected with the particular business of the present treatise, it has been our object to convey to the general reader some idea of the wonderful operations which are constantly taking place in every particle of matter which he sees around him, or to use the language of Paley, some notion of the "concealed and internal operations of the machine." These operations may not be as we have represented them; they may in fact be altogether different; but be this as it will, a perusal however cursory, of what has been stated, can hardly fail to accomplish one purpose we had in view, viz: to show to the most incurious and superficial reader that in the minutest fragment of matter, and in the commonest and simplest operations which take place in nature, and which he is altogether too apt to overlook, the most wonderful and extraordinary arrangements, *must* take place; arrangements which, if duly considered, are calculated fully as much, if not more, than those connected with the more striking and obvious phenomena, to excite his wonder, and at the same time to display the wisdom and power of the great Creator. The second object we aimed at, was, as just stated, to give a connected and popular sketch of molecular forces and operations; and by placing them in a point of view in which we believe they have not hitherto been considered, to display the beautiful simplicity and analogy that prevail throughout the whole.

Finally, it remains, before we close, to state briefly the arguments deducible from the divisibility and molecular constitution of matter, with reference to our present subject. These arguments may be considered under the three following heads; first, that matter has not *always* existed in its present form; secondly, it could not have existed in its present form by *chance*; and thirdly, and consequently, that it must have been the work of a voluntary and *intelligent* Being. Other deductions might doubtless be made from what has been

stated, but these we purposely avoid, and confine our arguments as much as possible to grounds admitting of no controversy.

In the first place, the divisibility and molecular constitution of matter seem to prove beyond a doubt that it cannot have *eternally* existed in its present state.

Although we can form no idea of what matter would be without its molecular properties, there is yet nothing in these properties which can induce us to believe that they are *necessary* to the mere *existence* of matter. On the contrary, we have seen that matter possesses qualities (those of gravitation) of a more primordial kind, to which its molecular properties are apparently secondary or subordinate. But if these subordinate properties be not necessary to the existence of matter, matter might *possibly* at some time have existed without them. Now this very possibility is incompatible with eternal existence; for eternal (passive) existence necessarily involves incapability of change. Hence the molecular constitution of matter, even in this point of view, must be supposed to have had a beginning; and when we consider the leading and characteristic property of matter in the molecular state, *viz. the endless repetition of exactly similar parts*, the difficulty of arriving at any other conclusion is exceedingly increased. It is to be observed also that the above remarks apply to the supposition of only *one* form of matter; but we shall see hereafter that chemists recognise upwards of *fifty* forms of matter, all of an elementary character; at least we cannot at present say that one of these forms is more elementary than another. Again, the number of molecules in each of these elementary principles, great as it is, is *limited*; the properties of the molecules also are fixed and definite, all which circumstances throw further insurmountable difficulties in the way of the supposition, that the whole have existed, as they now exist, from eternity. For how has it happened, it may be asked, that the number and properties of the elements, and the molecules of which they consist, are just what the economy of nature requires, and neither greater, nor less, nor different? How has it happened, that what is supposed to be infinite in some respects, should be finite and limited in those respects in which we are actually able to trace them; and what is more, most luckily finite and limited just where they appear to be required to be so? He who can satisfactorily answer these questions may contend with some prospect of success for the eternity of matter and its properties in their present form. In the mean time we assert without fear of contradiction, that the molecular constitution of matter is decidedly artificial; or to use the words of a celebrated writer, that the molecules of matter have all "the essential characters of a manufactured article,"* and consequently are not eternal.

Secondly, if the present molecular constitution of matter has not

* Sir J. Herschel on the Study of Natural Philosophy, p 38.

always existed, it must have been produced at some time, by some cause superior to itself. Now this cause must have operated either accidentally and by *chance*; or voluntarily and under the influence of a *will*.

With respect to the first of these alternatives, viz. chance; the *endless repetition of similar parts* presented by the molecular constitution of matter seems absolutely to preclude this supposition. Do we not consider it a subject of wonder to see even two or three things by chance alike, as for example two or three human faces? Should we not consider the man absolutely mad, who would attribute the uniform and manœuvres of a regiment of soldiers to chance? and can we then resist the argument in the infinitely stronger shape in which it is here presented to us! Thus, as the idea of chance seems too monstrous to be entertained for a moment by any rational being we are driven irresistibly to the other conclusion, viz. that the cause or agent who formed the molecular constitution of matter was a *voluntary agent or Being*; and moreover that this Being possessed a *power commensurate with his will*.

Thirdly; the agent or Being who constructed the wonderful system we have been considering must have been as *intelligent* as he was powerful.

We infer intelligence in an agent from the fitness and adaptation to certain ends exemplified in his works. Thus, when we see a machine admirably fitted for the office it performs, we infer that the maker of that machine must have possessed intelligence. Now if we judge of the molecular constitution of matter by this rule, we shall find that there is not only the most extraordinary fitness and adaptation to circumstances displayed in its arrangements, as far as we can understand them, but evidently much farther; that is to say, the maker of this system must not only have possessed intelligence, but intelligence infinitely surpassing our own. Thus at the very beginning, the selection of the molecular form of matter out of the many possible forms which might be supposed to exist, may be considered as an instance of intelligence of the highest kind; for this alone, of all the forms that can be conceived, seems best adapted to the purposes of creation. Indeed, on what other supposition, than that of the subdivision of matter into *minute similar parts*, could all those endless operations which we see constantly going on in the world, be imagined to take place? Moreover, the nature of the powers with which the molecules of matter are endowed is truly astonishing, and calculated in the highest degree to impress us with exalted notions of the intelligence and power of their contriver. Thus, what can be more wonderful, than that the self-same *chemical forces* differently directed should produce, not only all that endless change of property, of form, and of condition which we see around us, and which are so beneficial and even necessary to our existence; but likewise some of the most terrible displays of power in nature; as for

instance, the utmost intensities of heat, of cold, and of light; the terrors of the thunderbolt, and the irresistible energies of the earthquake! Nor, on the other hand, are the *cohesive* affinities existing among the molecules of matter much less wonderful or important; for if *similar* molecules had not been constituted with self-attractive and self-repulsive powers, there would have been no aggregation of the same matter into symmetrical groups, no order or regularity, no separation or purity; in short there would have been no common bond of union, and the whole would have been dispersed throughout nature, as accident or other circumstances might determine. Hence the present order of things could not have existed unless the molecules of matter had been endowed with *both* these properties; one of which the *chemical*, as it were, goes before and imperiously determines what molecules shall be combined or separated; while the other, the *cohesive*, silent and unobtrusive, follows in its train, and industriously assorting and arranging its predecessors' labours, here perhaps forms a diamond, or there superintends the integrity of the atmosphere!

Such are molecular forces as they obviously appear to us, and such the arguments deducible from them. But when we attempt to go further, and inquire into the intimate nature of these forces, we not only find much that is unknown to us, but much that apparently surpasses our utmost conception! And what a still more sublime idea is this calculated to convey to us of the wisdom and power of that Being who contrived and made the whole! When and where, do we naturally exclaim, did this Being exist? whence his wisdom, and whence his power? There is, there can be, but one answer to these inquiries. The Being who contrived and made all these things must have pre-existed from eternity—must have been omniscient—must have been omnipotent—MUST HAVE BEEN GOD!

CHAPTER IV.

OF CHEMICAL ELEMENTARY PRINCIPLES, AND OF THE LAWS OF THEIR COMBINATION.

IN the preceding chapter we have endeavoured to show that the minutest fragment of homogeneous matter cognisable by our senses is composed of innumerable molecules, all of which are exactly alike in size, in shape, in properties, in short, of every kind; and we argued that these facts incontestably prove that these molecules could not always have existed in their present form, nor have been formed by chance, but that they must have had a beginning, and

have been the work of a Creator. Now when we consider the prodigious quantity of matter composing our globe (to go no further) or even composing a portion of it, as for example, the mass of water existing in the ocean, and reflect that every individual molecule of this water possesses properties exactly like those of the drop we formerly contemplated, our argument, already sufficiently convincing, actually overwhelms us with its force. Still however it admits of further corroboration; and we proceed now to show that all this vast assemblage of molecules, so numerous, so diversified, so extraordinary as they are, may be reduced to a very few elementary groups, upon the endless combinations and separations of which all the phenomena of chemistry depend.

SECTION. I.

Of Chemical Elementary Principles.

THE substances at present considered as elementary amount to about fifty-four. Of these several possess certain properties in common, though they all differ from one another in subordinate particulars, or in other words, are specifically different. Of the whole number not above two or three exist in any great quantity in an uncombined state, at least in those parts of our globe to which we have access, but the whole are wrapped up as it were and have their properties concealed in compounds. Under ordinary circumstances most elementary principles exist as solids, but some of the more important occur in a gaseous form, and one or two as fluids. A few of them are *apparently* of so little consequence in the world, that if they were annihilated they would scarcely be missed; while others of them, on the other hand, are so obviously necessary to the existence of the present order of things, that the least derangement or alteration in their proportion or quantity would be fatal to the whole. Some of these elementary substances exist in such enormous quantities as to constitute a large proportion of the whole visible bulk of our globe, while others again, occur in such minute proportion, at least within our reach, as to be obtained with difficulty and not without elaborate research. With respect to the facility with which they enter into combination, and the obstinacy with which they unite, they differ also very remarkably; a few of them combining readily in a variety of proportions with almost all the rest, while some of the others can be scarcely made to combine under any circumstances. Lastly, with respect to the influences which different elementary substances are capable of exerting upon organic life, these are equally striking. A large majority of them indeed may, in their simple state, be considered of a deleterious nature; while three or four of them, on the other hand, make or-

ganized beings what they are, and are necessary to their very existence.

Such are a few of the leading properties of the elementary principles as we are at present acquainted with them; in the following table from Dr. Thomson they are arranged, as far perhaps as is practicable, according to their chemical characters.

TABLE.

1 Oxygen.	14 Arsenic.	27 Calcium.	41 Zinc.
2 Chlorine.	15 Antimony.	28 Magnesium.	42 Cadmium.
3 Bromine.	16 Tellurium.	29 Strontium.	43 Lead.
4 Iodine.	17 Chromium.	30 Baryum.	44 Tin.
5 Fluorine.	18 Uranium.	31 Aluminum.	45 Bismuth.
6 Hydrogen.	19 Vanadium.	32 Clucinum.	46 Copper.
7 Carbon.	20 Molybdænum.	33 Yttrium.	47 Mercury.
8 Azote.	21 Tungsten.	34 Zirconium.	48 Silver.
9 Boron.	22 Titanium.	35 Thorinum.	49 Gold.
10 Silicon.	23 Columbium.	36 Iron.	50 Platinum.
11 Phosphorus.	24 Potassium.	37 Manganese.	51 Palladium.
12 Sulphur.	25 Sodium.	38 Nickel.	52 Rhodium.
13 Selenium.	26 Lithium.	39 Cobalt.	53 Iridium.
		40 Cerium.	54 Osmium.

It is foreign to the object of this work to enter into a minute description of these bodies; we shall therefore content ourselves with such a view of them as may enable the general reader to form some idea of their properties, and to follow us without much difficulty in our subsequent remarks.

The five first bodies, *Oxygen*, *Chlorine*, *Bromine*, *Iodine*, and *Fluorine*, are usually termed supporters of combustion. They have some properties in common, though in other respects, and particularly in their apparent relative importance in the economy of nature they differ exceedingly. They are remarkable for the tendency they have, not only to combine with one another, but with almost all the bodies below them in the table; and their union, particularly that of oxygen, is usually accompanied with the extrication of more or less of heat and light, and constitutes the well-known phenomena termed *combustion*.

(1) *Oxygen* is one of the very few elementary substances that occur naturally in the gaseous form, in which form it constitutes

1. Oxygen, from *οξυς*, acid, and *γεννίω*, to generate; from its property of forming acids. 2. Chlorine, from *χλωρος*, green; so called from its colour. 3. Bromine, from *βρωμος*, fetid; so called from its strong odour. 4. Iodine, from *ἰοειδής* violet; from the colour it assumes in the gaseous state. 6. Hydrogen, from *ἵδωρ*, water, and *γεννίω*, to generate. 8. Azote, from a privative and *ζωή*, life; from its being incapable of supporting life. 13. Selenium, from *Σελήνη*, the moon. 17. Chromium, from *χρῶμα* colour; so called from the beautiful colours of some of its salts. 18. Uranium, from *οὐρανός*, the heavens. 19. Vanadium, from *vanadis*, a Scandinavian deity. 20. Molybdænum, from *Μολύβδαινα*, lead. 22. Titanium, from *Τίτανος*, calx. 23. Columbium, from Columbia, in America, where it was

about one fifth part of common air. As the world at present exists, oxygen, perhaps, may be fairly considered as one of the most important, if not the most important substance in it. From its proneness to enter into composition it is constantly operating upon, and modifying everything. By far the greater proportion of mineral bodies forming the crust of the earth, contain more or less of it; and in all plants and animals it actually exists as a constituent elementary principle. In short, the properties of oxygen stamp it as an element and subordinate agent of the most important kind; while the numberless contrivances which are observable in nature, to secure, or evade, or modify its operations, are most extraordinary, and exhibit some of the most marked and unequivocal evidences of design on the part of their great Contriver, that we meet with among his works. Several of the most important of these contrivances we shall have occasion to allude to hereafter; but there is one of so curious and interesting a character that it may be mentioned here as an illustration of the above remarks. The nature and mechanism of the function of respiration will be explained elsewhere, and it is sufficient for our present purpose to state that, by means of a complicated apparatus, the blood is made to circulate through the lungs, in order that it may be there exposed to the oxygen of the atmosphere. For purposes beyond our comprehension, but probably in part at least with a view to the future creation of organized beings, the great Architect of the universe had willed that this principle should exist upon the surface of our globe in a gaseous state; when he created animals he chose also to render them dependent upon oxygen for their existence; and he effects his object, not by bending this principle to his purpose, by altering its physical or other properties; not by obtaining it from water, or any of the innumerable compounds into which it enters, which according to our imperfect notions he might have more easily done; but, as if on purpose to display his power and design, he rigidly adheres to the properties, both mechanical and chemical, imparted to oxygen, and to these properties accommodates his future labours! The whole therefore of the complicated and beautiful apparatus, connected with the respiration of animals, is most obviously designed and constructed with reference to the properties of the oxygen of the atmosphere, and altogether they afford one of the most striking evidences of adaptation and design presented to us in nature.

(2) *Chlorine* in its elementary state is a gas, having all the mechanical properties of common air, but in this form it never

first found. 26. Lithium, from *Λίθος*, a stone. 29. Strontium, from Strontian, the name of a place in Scotland, where first found. 30. Baryum, from *Βαρύς*, heavy. Aluminum, from *Alumen*, alum. 32. Glucinum, from *Γλυκύς*, sweet; from the taste of some of its salts. 52. Rhodium, from *Ῥόδον*, a rose; from the colour of some of its compounds. Iridium, from *ἶρις* the rainbow; from the variety of colours assumed by some of its salts. 54. Osmium, from *ὄσμιον*, odour; from the strong smell emitted by some of its compounds.

occurs naturally. It exists however in great abundance in a state of combination, from which it may be readily obtained by easy chemical processes. One of the most abundant sources of chlorine is *common salt*, into which it enters in the proportion of about 60 per cent. As compared with oxygen chlorine is much less abundant and perhaps important; yet it is doubtful if without chlorine the present order of things could proceed. Take for example the familiar instance of common salt above referred to. Let us consider the universal diffusion of this substance throughout nature—what the sea would be, or how animals could exist, without it—let us consider these and the numberless other operations which this valuable compound more or less enters into, or influences, and we shall be able to form some notion of the part chlorine bears in the economy of nature. On the other hand, when we reflect that were chlorine to be extricated from its state of combination, and made to exist, like oxygen, in a gaseous form, that it would instantly prove fatal to organized beings; can we fail to be struck with the very obvious design thus displayed in rendering its quantity and combining powers such as to keep it in a state of union, and by these means to secure all its useful without its deleterious properties?

(3) (4) *Bromine* and *Iodine*, the next two substances, are found principally in sea-water and in marine productions. They appear to exist in very minute proportion, and always in a state of combination. *Bromine* exists under ordinary circumstances as a deep-coloured red fluid, having a very strong and offensive odour; *Iodine* is a crystallized solid, volatile by a slight increase of temperature, and forming a beautiful violet vapour. Bromine and Iodine more nearly resemble chlorine than oxygen in their properties, though they differ materially from both, and their use in the economy of nature is absolutely unknown. It may however be observed that *Iodine* has lately been much celebrated for its medicinal properties.*

(5) *Fluorine* has been rather inferred than demonstrated to exist. It occurs principally in the mineral called *Fluor Spar*, in a state of combination with lime, and in this state it would seem to be harmless; but in a state of purity it is exceedingly deleterious. One of its most remarkable properties is that of corroding glass.

* It may not be amiss to observe here that the author of the present volume first employed the hydriodate of potash, as a remedy for goitre, in the year 1816, after having previously ascertained, by experiments upon himself, that it was not poisonous in small doses as had been represented. Some time before the period stated, this substance had been found in certain marine productions; and it struck the author that burnt sponge (a well known remedy for goitre) might owe its properties to the presence of Iodine, and this was his motive for making the trial. He lost sight of the case in which the remedy was employed, before any visible alteration was made in the state of the disease; but not before some of the most striking effects of the remedy were observed. The above employment of the compounds of Iodine in medicine was at the time made no secret; and so early as 1819, the remedy was adopted in St. Thomas' Hospital, by Dr. Elliotson, at the author's suggestion.

We pass on now to a very different class of substances, and which instead of having the power of supporting combustion in other substances, are for the most part themselves combustible. Of these, the first and perhaps the most important we have to notice is

(6) *Hydrogen*. This principle in its elementary state exists as a gas, having all the mechanical properties of common air. In this state it is exceedingly inflammable; and if mixed with oxygen, and if the mixture be exposed to heat, the two gases unite suddenly and violently with a loud explosion; while the result of the combustion is *water*. Hydrogen is the lightest body known, and under the same bulk therefore contains less matter than any other body. It does not exist naturally in a separate state, but always in combination; and by far most generally and abundantly in combination with oxygen in the form of water. Hydrogen ranks perhaps next to oxygen in importance; at least as far as organized beings are concerned; since like oxygen it constitutes one of the elementary principles of which they are formed. It differs however remarkably from oxygen, in not being in its elementary state necessary to the existence of organized beings; indeed hydrogen is actually incompatible with the existence of animals, if not of vegetables; and its properties as an element have evidently been sacrificed to its properties as a compound, that is to say, to its properties as *water*. Hence we have to admire the happy adjustment of the quantities of the two elements to each other, so that the oxygen shall predominate; an adjustment that can scarcely be explained upon any other supposition than that of design; for any other cause, or chance, would have been quite as likely to have produced an excess of hydrogen as of oxygen, or at least anything but the exact proportions required. Lastly, it may be remarked, that to the relative proportions of oxygen and hydrogen existing on our globe, more than perhaps to any other subordinate cause, the present order of things owes its stability. For the proportions of these principles are so happily adjusted and balanced, and all the numerous operations dependent upon them are, in consequence, so firmly established, that no material change can possibly happen to any part from an internal cause, but if changed at all, the whole must be changed from without.

(7) *Carbon*, or charcoal, is a substance too well known in its ordinary state to require description; in its crystallized and pure state it is found to constitute the *diamond*, the hardest and most brilliant body in nature; a circumstance that certainly could not have been anticipated, but which affords a most striking instance of the effects produced by the different modes in which molecules of the same matter may be aggregated. Carbon perhaps more than any other principle may be considered as constituting the staminal or fundamental element entering into the composition of organized beings. This is particularly the case in principles from the vegetable kingdom, which owe their peculiar character essentially to carbon, and

their endless varieties to differences in its quantity, and to the modifying influence of the hydrogen and oxygen with which it is associated. In animal substances, carbon exerts a similar influence, but its effects are materially modified by the presence of another staminal principle to be presently considered. Carbon, in some state or other, exists in considerable quantities upon the surface of our globe, but apparently by no means in so large a proportion as oxygen and hydrogen. Exclusively of that actually involved in the composition of organized beings, carbon is met with nearly pure in large quantities in particular districts in the well-known form of *fossil coals*; but it occurs in far greater proportion, in combination with oxygen in the form of *carbonic acid*; which carbonic acid in union with lime, constitutes common *chalk* and *limestone*, two of the most abundant minerals in nature.* Carbon in its elementary state, is a very inert substance, and is scarcely liable to be affected by, or to affect organized beings; but with hydrogen and oxygen it forms gaseous compounds of great activity, and capable of proving instantly fatal to animals respiring them. Such effects, however, appear to be obviated by a beautiful expedient which we shall have occasion more particularly to notice hereafter. In the mean time it may be observed, that though the compound of carbon and oxygen (*carbonic acid*) is by innumerable processes constantly forming around us in enormous quantities; by some compensating means it disappears as fast as it is formed; so that the atmosphere, which without this provision would probably before now have become contaminated by carbonic acid to an extent fatal to animal life, barely contains traces of it.

(8) *Azote* or *nitrogen* is one of the very few elementary principles which exist naturally in an uncombined state. It constitutes about 4-5ths or 80 per cent. of common air, the rest being principally oxygen. The great bulk of this principle in existence is confined to the atmosphere, and to animal substances, of which it forms a constituent element; and it enters very little into natural mineral productions. In its pure state, azote is remarkable for its negative properties, that is to say, for the difficulty with which it enters into combination with other matters. Thus it is neither combustible nor a supporter of combustion; is neither acid nor alkaline; possesses neither taste nor smell; nor does it directly combine with any other known substance. Yet when made by peculiar management to unite with oxygen, hydrogen, or carbon, azote forms some of the most energetic compounds we possess: thus, *mixed* with oxygen it

* In order to give some idea of the proportion in which carbon exists in different common substances, it may be observed that a pound of charcoal is equal to, and is contained in rather more than, two pounds of sugar or flour, and eight of potatoes or limestone; so that a mountain of limestone contains the essential element of at least an equal bulk of potatoes, and of a forest that would amply cover many such mountains.

forms atmospheric air, as before observed; *united* with oxygen it forms *aqua fortis*, the most corrosive of liquids; *united* with hydrogen it forms the *volatile alkali* or ammonia, likewise an energetic compound, but of an opposite nature; while united with carbon and hydrogen, it forms *prussic acid*, the most virulent poison in existence! Azote may be considered as constituting the characteristic element of animal substances, and as imparting to them their peculiar properties; in this point of view therefore it is a principle of very great importance. Moreover, the above mentioned negative properties of azote are evidently of a primordial kind, and seem to have been formed with reference to future creations, which all have been most carefully and rigidly adapted to them. Thus had the properties of azote not been negative, those of its most important compound, atmospheric air could not have been negative; and atmospheric air might have been acid or alkaline, or have possessed odour or colour; either of which circumstances would have been incompatible with the present order of things.

(9) (10) *Boron* and *Silicon*. The next two substances obtain their names from *borax* and *silex*, the natural productions in which they exist in a state of combination. Borax is a saline production chiefly found in certain lakes in Thibet and China. Boron, the elementary substance obtainable from it, is a deep brown powder possessing neither taste nor smell, but highly inflammable at a temperature below a red heat. Silicon is the elementary basis of *silex* or common flint, one of the most abundant minerals in nature. Silicon is a brown powder very similar to boron in appearance, and like it inflammable under certain circumstances. These two elementary principles do not exist naturally, but have been formed by elaborate chemical processes in small quantities only. They seem to be more nearly allied to carbon, in their properties, than to any other elementary product. Borax exists in very small quantities, and its use in the economy of nature is not apparent. *Silex* on the other hand is a most important production, and in its hardness, insolubility, and other refractory properties, we recognise a substance admirably adapted for the purpose to which it has evidently been designed, viz. that of constituting the stamina or ground-work, as it were, of our globe, and which could not be withdrawn without subverting the whole. *Silex* is found in small quantities both in plants and in animals, but does not, like hydrogen, oxygen, carbon, and azote, form a constituent element of organized beings.

(11) *Phosphorus*, under ordinary circumstances, is a pale amber-coloured substance, very like wax in appearance, but so exceedingly combustible that it cannot be heated, much less melted in the open air, without immediately taking fire. Under these circumstances, as may be supposed, it does not exist naturally, but is obtained by an elaborate process from various compounds into which it enters; as for example, from *bone earth*, or the earthy basis of the bones of

animals; and also from certain salts. It exists also in the mineral kingdom in certain districts in considerable quantities, but upon the whole, it is not an abundant principle. Phosphorus affords another beautiful instance in which the design has been directed to the properties of the compound, rather than to the element itself. The *phosphate of lime* or bone earth was apparently the thing wanted to constitute the bony skeleton of animals, and accordingly, to this compound the properties of the element itself seem to have been sacrificed. Neither lime itself in mass, nor any of its mineral compounds, appear to be adapted for forming a constituent principle of a living organized being. It was necessary therefore to have a connecting medium, or link, that should unite organization with the mineral constituent, and phosphorus admirably accomplishes this object. Accordingly, we see that organization goes on in conjunction with lime in the bones of animals, through the medium of this element, quite as readily as in other parts of their system; whereas when phosphorus is absent, as in shells, and in other deposits of carbonate of lime, the carbonate of lime is extravascular, and seems to form no part of the living system. There are also other important offices which this principle evidently performs in the animal economy, some of which we shall have occasion to refer to hereafter.

(12) *Sulphur*. This well-known substance is one of the very few that exist naturally in an elementary state. It is a very abundant and probably important principle in the economy of nature, as it not only exists in large quantities in the mineral kingdom, but in a greater or less proportion in almost all animal, and in many vegetable products. Its uses, however, at present, are very imperfectly understood. Sulphur combines with hydrogen, and forms a very deleterious gaseous compound. Its combinations with oxygen are generally acid, and very active in their concentrated form, but not poisonous.

(13) *Selenium*, the next substance, is found in very minute quantities generally associated with sulphur, which in its properties it somewhat resembles; or rather, perhaps it appears to constitute the connecting link between sulphur and the metals. The uses of selenium in the economy of nature are unknown; but we shall have occasion hereafter to refer to its compound with hydrogen, which is even more deleterious than the compound of sulphur with this element.

(14) *Arsenic* in its pure state is a metalloid, or imperfectly metallic substance, having much the appearance of polished steel. In the form in which it is popularly known, as *white arsenic*, it is combined with oxygen, and constitutes one of the most virulent of poisons. Arsenic exists in certain minerals in considerable quantities, and seems in every form, to be incompatible with organic life.

(15) *Antimony* is usually found in nature associated with sulphur, the compound it forms with which, was for a long time considered as the metal itself. In its pure state, antimony has a bluish-gray colour, and possesses considerable metallic splendour, but in this form it seldom occurs in nature. The compounds of antimony are active medicinal agents, and some of them are much employed for that purpose.

(16) (17) (18) (19) (20) (21) (22) (23) *Tellurium, Chromium; Uranium, Vanadium, Molybdænum, Tungsten, Titanium, and Columbium*, the next eight substances, are metals, for the most part obtained by elaborate processes from rare mineral productions. The most important, as well perhaps as the most abundant of these substances, is chromium, the compounds of which, from the splendour of their colours, have been lately much employed in the arts. It may be remarked of all these substances, that at present their use in the economy of nature is quite unknown to us.

(24) (25) *Potassium and Sodium* are the metallic bases of the two well-known alkaline substances, *potash and soda*, which are compounds of these metals with oxygen. Such, however, are the powerful affinities of the metallic bases for oxygen, that they nowhere exist naturally upon the surface of our globe. The same may be also remarked of potash and soda, the powerful alkaline properties of which prevent them from existing separately. In this respect, the compounds these metals form with oxygen, present a striking contrast with the compounds they form with the analogous principle, chlorine; the compounds of potassium and sodium with chlorine (the latter of which constitutes common salt,) are remarkable for their fixed permanent character, and for the little tendency in general which they have, to enter into a further state of combination. Besides their remarkable avidity for oxygen, potassium and sodium possess some other unusual properties. Potassium, for example, is so light, that were it compatible with water, it would swim on the surface of that fluid; a circumstance we can hardly imagine to happen with a metal. Potash and soda in all their forms are most important principles, and evidently are necessary to the existence of the present order of things, both mineral and organized; for there are few organized beings that do not contain more or less of them, especially of soda. Potash is found more particularly in plants, but exists also in animals; while the universal presence of soda in animals, in the form of common salt has been already referred to, and is generally known. These alkalis present us with a beautiful instance of adaptation, for the purposes which they seem destined to fulfil in the operations of nature. Had they been solids, or had they formed solid compounds, like many of the preceding principles, they would have been totally unfitted for their peculiar office, that is to say, for forming a constituent element of the fluids of organized beings.

(26) *Lithium* is the metallic basis of *lithia*, a substance recently discovered, and intermediate in its properties between the alkalis and the earths to be next considered. It has hitherto been met with, in some rare minerals, in small quantities only.

(27) *Calcium*, the metallic bases of *lime*, can be obtained only by a troublesome and difficult process, and of course does not exist naturally. It is a white metal like silver, and by union with oxygen is readily convertible into lime. This well-known principle exists in the greatest abundance in nature, not as quick-lime, but united with carbon and oxygen, in the form of common limestone, marble, &c. The great importance of lime in the economy of nature is too obvious to require notice, and it is only necessary to revert to the fact that this earth is one of the very few mineral productions capable of forming a part of a living organized being; at least in any quantity. This earth, as formerly noticed, constitutes with phosphorus and oxygen, the basis of the bones of animals; and with carbon and oxygen, all the endless variety of shells and similar products. Thus the properties of lime furnish another striking instance of adaptation to a particular purpose. The compounds of potash and soda are all very soluble in water, and hence are chiefly confined to the *fluids* of animals, in which their presence is indispensable. But a solid framework or skeleton was necessary to the existence of the more perfect animals, and as this could not be formed from the soluble potash or soda, the introduction of another mineral substance possessed of the requisite properties was necessary. Now lime, some of the compounds of which are *solid* and some *fluid*, is admirably adapted for the purpose; and lime accordingly has been chosen: the lime is carried, in a state of solution, to the spot where it is required, and is there converted into a *solid*; while by the same agency, when necessary, this solid is again converted into a fluid and removed! It seems impossible to conceive arrangements to present more striking evidences of adaptation than these; and the more we consider the subject in all its bearings, the more wonderful does it appear.

(28) *Magnesium* is the metallic basis of the well-known earth called *magnesia*. It is said to resemble calcium in its properties, and like that principle does not exist naturally, at least upon the surface of our globe. Magnesia, though occurring most abundantly in nature, and entering very largely into the composition of rocks, does not, like lime, constitute masses of great extent in the same simple state of combination; that is to say, there are no mountains of magnesia, as there are of chalk and of limestone. Magnesia, even more decidedly than the three preceding mineral substances, seems to be necessary to the existence of organized beings; as there does not appear to be one, in which traces of this earth are not met with, generally associated with phosphorus. Its uses, however, are less obvious than those of the three other substances, and indeed may be

said to be unknown; though there is reason to believe that it is most intimately connected with the vital operations of organized beings.

(29) (30) *Strontium*, and *Baryum*, the metallic bases of the two earthy bodies *strontia* and *baryta*, are allied to calcium and magnesium in some of their properties, but differ exceedingly from them in others. Their combination with oxygen exhibit still more decidedly alkaline powers than those of either calcium or magnesium, and in consequence, like them, they only exist in various states of combination; and most usually with carbon and oxygen, or with sulphur and oxygen. Compared with lime and magnesia, *strontia* and *baryta* exist but sparingly, and neither of them has anything to do with organization; indeed many of the combinations of *baryum* are virulent poisons.

(31) *Aluminum* is the metallic basis of the earth *alumina*, the characteristic ingredient of the well-known salt called *alum*. The metallic basis, like the preceding, nowhere exists; but *alumina*, the compound of aluminum and oxygen, is one of the most abundant productions of nature, and constitutes an ingredient in by far the greater number of rocks and soils upon the surface of the globe. The different kinds of clay, also, of which bricks, earthenware, &c., are formed, consist chiefly of this earth in different states of purity; so that it is a substance of great utility and importance. *Alumina* appears to have nothing to do with organization; at least it is not known to form a necessary constituent of any organized being, either vegetable or animal; though it is in constant communication with organized beings, and appears to be almost necessary, in some indirect way, to their existence. This fact is very remarkable; for as the earth does not appear to be poisonous, it could scarcely have been so completely excluded from living bodies, except by some design beyond our comprehension.

(32) (33) (34) (35) *Glucinum*, *Yttrium*, *Zirconium*, and *Thorinum*, the four next elementary principles are the metallic bases of substances, usually considered as possessing the characters of earthy bodies, and denominated *Glucina*, *Ytria*, *Zirconia*, and *Thorina*. They all appear to exist very sparingly in nature, and are only met with in some rare minerals. *Glucina* has been hitherto met with only in precious stones denominated the *emerald*, the *beryl*, and the *euclase*; *yttria* and *thorina* in some rare Swedish and Norwegian minerals; and *zirconia* in the *jargon* or *zircon* from Ceylon, and in the *hyacinth*. These earths more nearly resemble *alumina* than any other substance.

(36) *Iron*, one of the most important, is also one of the most abundant principles in nature. It is met with occasionally in the metallic state, but most generally it is found mineralized in various ways, and can only be obtained pure by an elaborate process. Iron exists in minute quantities in almost all vegetable and animal pro-

ducts, particularly in the blood; though its mode of combination, as well as its precise use, are quite unknown. Iron may justly be considered as the most useful of all the metals, and the one that has perhaps contributed more towards the civilization of mankind than any other. To form some idea of its use, we have only to reflect what would happen if it were annihilated. What substitute could be found for it in all the numerous instances in which it contributes to the wants or to the comforts of mankind; particularly through the medium of tools, of almost every one of which it constitutes the essential material. In short, when we contemplate all the circumstances connected with this metal, its abundance, the manner in which it is mineralized, and the occasion which it thus gives to human ingenuity to extract it from its ores; its wholesomeness (for many of the metals are poisonous); its properties, particularly its extraordinary tenacity; its strength, its property of welding, of being converted into steel, and in this form of being tempered to any degree of hardness we choose; its magnetic properties, &c.,—when we contemplate all these circumstances, it is impossible not to be struck with such varied usefulness, and to consider iron, not only as an article evidently designed for the benefit of man, but as the instrument by which he should conquer and govern the world; and thus be enabled to place himself, where it was evidently intended he should be, at the head of the creation.

(37) *Manganese* somewhat resembles iron in a few of its properties. It may be obtained from its ores by an elaborate process, but in this form it is little known or used. Manganese exists in minute quantities in certain mineral waters, and in a few animal products; and its combinations with oxygen, are not only employed in the arts, but by the chemist, who frequently procures oxygen for his experiments from the ores of manganese. Though much diffused, manganese is not a very abundant metal, at least compared with iron, and its uses in the economy of nature are apparently much less important.

(38) (39) *Nickel* and *Cobalt*, are two metals somewhat resembling each other in a few of their properties, and their ores are often associated in nature. It is remarkable also that they are both generally found combined with iron in those bodies, which occasionally fall from the atmosphere, and which are considered as of meteoric origin. Like iron also both these metals are capable of becoming magnetic. Cobalt is used in the arts, and is the basis of the blue colour upon our earthenware; but neither this metal nor nickel are to be compared with iron in point of utility, nor are they very abundant productions.

(40) *Cerium* is a metal very little known, and has hitherto been obtained, in minute quantities only, from some rare minerals occurring in Sweden and in Greenland.

(41) (42) *Zinc*, *Cadmium*. These two metals are generally

associated in nature, and somewhat resemble each other in their properties; but the last is comparatively much less abundant, and has been only recently discovered. Zinc is a metal easily fusible, of a bluish white colour, and of a lamellated brittle texture; though by peculiar management it may be rendered malleable. It is an ingredient in the well-known compound metal, *brass*, and in this form is much used and is of considerable importance.

(43) *Lead*. This well-known metal is not found in its metallic state, but its ores are very abundant, and most of the lead of commerce is extracted from the mineral called *galena*, which is a compound of lead and sulphur. The general properties of lead and of its compounds render it of considerable importance; but its poisonous properties are a considerable drawback to its usefulness. Why lead, and other mineral matters, should have been constituted poisonous is a question beyond our reach; and all we can at present venture to state on this and on similar points is, that it is not actually necessary that man should employ lead or other poisons, and that he may, if he chooses, avoid their deleterious properties.

(44) *Tin*. This useful metal has been employed by man from the most remote antiquity, though it nowhere exists naturally in its metallic state, but usually in conjunction with oxygen. Tin is not a very abundant metal, being apparently confined to a few localities only, one of the most noted of which is Cornwall. It is much used in the arts, and hence is of considerable importance.

(45) *Bismuth* occurs in nature both in the metallic state and in various states of combination. It has a reddish-white colour and a lamellated brittle texture, and is easily fusible. Bismuth is not a very abundant metal, and is not much employed.

(46) *Copper* occurs in nature in the metallic state, but much more frequently mineralized, especially with sulphur. The valuable properties of copper, both in its pure and mixed state, render it of considerable importance; and it is in consequence much employed in the arts. With zinc it constitutes *brass*; with tin *bell-metal*; both well-known compounds. Copper has been lately said to exist in very minute quantities in organic nature, but whether as an accidental, or as an essential ingredient is not known. The compounds of copper are poisonous, but these poisonous properties, like those of lead, can be easily obviated and guarded against.

(47) *Mercury*. This well-known fluid metal occurs in the metallic state, but more frequently mineralized, especially with sulphur. Its importance in the arts, and as a medicinal agent, are too well known to require mention here. The fluidity of mercury presents a beautiful instance of the endless diversity of nature, and adds much to its importance and usefulness. Mercury exists in considerable abundance, though much less so than many of the preceding elementary principles.

(48) (49) *Silver* and *Gold*, and their uses, are too familiar to re-

quire enumeration. They are both met with in the metallic state, but silver also occurs mineralized. So unimportant a part do they seem to perform in the economy of nature, that if they were annihilated, it is probable that the world would go on just as well without them. How different in these respects from iron, and how much less therefore intrinsically valuable! Independently of their beauty, the only really valuable properties of silver and gold are the difficulty with which they are acted on by heat and other extraneous agents, properties, which if they were more abundant, would render them well adapted for a great many useful purposes.

(50) (51) (52) (53) (54) *Platinum, Palladium, Rhodium, Iridium, and Osmium*, are metallic substances usually found associated in small quantities, chiefly in certain districts of South America, but recently also in the old world. Platinum, the most abundant and important of them, is the heaviest body in nature. It is scarcely acted on by any ordinary agents, but it may be welded by heat; properties which render it exceedingly valuable for many purposes, and make us regret that it is not more abundant. Palladium somewhat resembles platinum in its properties, but occurs in less quantity. The other three metals exist in very minute quantities, and their properties are very little known.

We have thus taken a summary view of the different elementary principles met with upon the surface of our globe, and of their leading compounds; and we are now to consider the laws which regulate the union of these principles with one another.

SECTION II.

Of the Laws of Chemical Combination.

As the following remarks upon the laws of chemical combination can scarcely be so given as to prove a source of interest to the general reader, he is desired to pass them over and to turn to the last section of the present chapter, where he will find a brief recapitulation of the leading facts, and of the arguments which they furnish in favour of design, and of the wisdom and power of the Creator.

In the preceding chapter we advanced a few of the leading arguments which induce us to adopt the hypothesis that *all gaseous bodies under the same pressure and temperature, contain an equal number of self-repulsive molecules*; and we have now to consider, very briefly, some of the important consequences to which this hypothesis naturally leads.

It seems to be satisfactorily established that bodies, in their gaseous state, combine both *chemically* and *cohesively* with reference to their volumes; that is to say, that the same volume of a gas always

combines with either precisely a similar volume of the same or of another gas, or with some multiple or submultiple of that gas (in other words with twice, or thrice, or half, or a quarter as much, &c.) but not with any intermediate proportion; and further, that the resulting compound always has reference by volume to the original volumes of its constituent elements. Let us take water for example. Water has been shown to consist of one volume of oxygen gas, and two volumes of hydrogen gas; and so invariably, that we cannot suppose water to be formed of any other proportions of these elements. It has been also shown that the resulting water, if in the state of steam, occupies exactly the space of two volumes, so that one volume has disappeared. Now let us consider attentively what must have happened during these changes. One volume of oxygen gas has contributed to form two volumes of water, which two volumes of water, according to our hypothesis, must consist of twice the number of self-repulsive molecules contained in the one volume of oxygen; yet every one of these molecules must contain oxygen, because oxygen is an essential element of water: it follows, therefore, irresistibly, that every self-repulsive molecule of oxygen *has been divided into two*, and consequently must have originally consisted of at least two elementary molecules, somehow or other associated, so as to have formed only one self-repulsive molecule. This conclusion, which seems to flow naturally from our premises, is most important, as we shall see immediately, and enables us to throw no small light upon many points deemed obscure. In the mean time let us consider briefly the nature of the compound self-repulsive molecule of oxygen.

We endeavoured to show in the previous chapter, that every ultimate molecule of matter must possess two kinds of polarity, which, for want of better terms, we denominated the *chemical* and the *cohesive*; and that these polarities bear the same relations to each other as electricity and magnetism; in other words that, like these forces, the polarities exist at right angles to each other. Hence if *A* and *B* be supposed to be two molecules of oxygen, of which *εε εε* represent the chemical poles and axis, and *μμ, mm* the cohesive, it is evident that these two molecules may be supposed to combine in two ways, either *ε* to *ε* chemically, or *μ* to *m* cohesively; but the latter form of course is most probable *from the similar nature of the molecules.**

* The general and strong analogy, if not identity, in all respects except *direction* between the axial and equatorial forces, has been already alluded to, and is exemplified by the striking resemblance between electricity and magnetism. We have seen also that in the crystallized state, similar molecules probably combine *chemically*. Hence, although the rule stated in the text be true, that *similar* molecules only combine *cohesively*; yet there may be, and probably are, instances in which they combine *chemically*. For the same reasons, *dissimilar* molecules may also occasionally combine *cohesively*. It is probable that such states of combination might be readily detected by the optical properties, or by some other peculiarity in the physical properties of bodies, if in a crystalline form; but by no other known means. Do not

Every self-repulsive molecule of oxygen, therefore, as it exists in a state of gas, must consist of *at least* two molecules, united to each other *cohesively*, and acting as a single one; and the same may be shown with respect to other gaseous bodies, as, for instance, hydrogen. It cannot, indeed, be inferred from the composition of water, as above stated, whether the self-repulsive molecule of hydrogen be double or not; but this may be demonstrated from other compounds into which hydrogen enters. Thus muriatic acid gas is composed of one volume of chlorine and one volume of hydrogen, which unite without any condensation, and form two volumes of muriatic acid gas; now in this case, it is evident that not only the self-repulsive molecule of hydrogen, but also that of the chlorine, must be double at least, like the molecule of oxygen above mentioned; and the same might be shown with respect to the other gaseous bodies.

We have said above that the self-repulsive molecules of oxygen and of hydrogen are *at least* double; but the probability is that they are in reality much more compounded, as the following observations will show. The self-repulsive molecule of water, on entering into combination, is often found to be divided into two or three (perhaps more) parts. Now as we cannot admit the division of an ultimate molecule or *atom*, we must of course conclude that the molecules of oxygen and of hydrogen are much more compounded than as above represented, and must each of them contain at least three component or sub-molecules. Hence the self-repulsive molecules of water will consist of at least nine component sub-molecules (*viz.* three of oxygen and six of hydrogen) which we may suppose to be associated,—in the first place the hydrogen with the oxygen, *chemically*; and afterwards the three sub-molecules of water with one another *cohesively*, so as to constitute one spheroidal molecule; in a manner that with a little ingenuity it would, perhaps, not be difficult to represent mechanically.*

Precisely the same laws of union may be supposed to prevail among the molecules of bodies themselves, as they actually exist around us. Thus let us take the crystal of oxalic acid as an instance for illustration. The acid is composed, according to the present language of chemists, of two molecules of carbon, and three of oxygen, which by combining, form the acid; while, to complete the compound molecule, and to adapt it for crystallization, three molecules of water are required to be somehow associated with each of the molecules of the acid. Now in this case, we sup-

some of the phenomena of *Isomerism*, that is to say, the property which the same body occasionally possesses of assuming different forms, depend upon these changes?

* When bodies, as, for example, water, are subjected to intense degrees of heat, it is not improbable that in many instances the self-repulsive molecules are more or less separated into their constituent sub-molecules; in which case of course the bodies may be supposed to exhibit altogether different elastic powers and laws of expansion.

pose, that the two molecules of carbon (each of which is perhaps already made up of several sub-molecules) are associated together into one symmetrical super-molecule; that the three molecules of oxygen are arranged in a similar manner, and then associated *chemically* with the super-molecule of carbon, and thus form by their union a molecule of oxalic acid; finally, that the three molecules of water are united in one super-molecule, which combines *chemically* with the molecule of oxalic acid, and thus completes the molecule of the acid as it actually exists in the crystalline form.

Such are the views we have been induced to take of the nature of chemical combination, and whether right or wrong, they have the merit of being exceedingly simple and consistent with themselves throughout, which can hardly be said of any others with which we are acquainted. Indeed much reflection upon the subject, for many years past, has satisfied us that chemical combinations can be rationally explained only in some such manner as we have supposed. Any lengthened argument, however, upon the laws of chemical combination here, would be quite out of place; we shall therefore confine ourselves to the following observations.

1. The above view of the molecular constitution of bodies naturally suggests the important question: do the sub-molecules, which we suppose to unite together cohesively and form the self-repulsive molecule, of oxygen and hydrogen for instance, possess the same properties as those of oxygen and hydrogen, or do they possess different properties? This question, in most instances, cannot, in the present state of our knowledge, be satisfactorily answered; though there is every reason to believe that the properties both of the sub-molecule and of the super-molecule generally differ from those of the molecule itself, but that the differences are rather of a specific than of a generic character.* Thus chemists have shown that different volumes of the same gaseous body, termed carburetted hydrogen, combine together and form various compounds: we have, for example, a gas, one volume of which contains two volumes of carburetted hydrogen; another, one volume of which contains three, and another four, of the same gaseous body. Now the sensible properties of all these compounds, though resembling each other in some respects, are yet specifically different; and as they are all composed of the same gaseous body in different proportions, these differences must be considered rather the result of cohesive than of chemical union. Thus the supposition, that both the sub-molecules and the super-molecules of bodies may possess properties different

* What we term the *sensible* properties of bodies are, of course, in all instances, the result of a great number of molecules acting together at the same time; hence below a certain point, mere difference of numbers may be supposed to produce a change in sensible properties, not only in degree, but in kind: of the sensible properties of a single molecule we can form no conception.

from one another and from the standard molecule, is rendered exceedingly probable by the above facts; and if our space admitted, it would not perhaps be difficult to bring forward other facts of the same kind. This however, would be foreign to our purpose; and we shall only remark, that a great many curious circumstances, at present but very imperfectly understood, evidently appear to be referable to a similar principle.

2. Although we have thus rendered it exceedingly probable that the molecules of bodies considered at present as elementary, are immediately compounded of many others more or less resembling them; yet it is obvious that there must be a point at which these and other elements exist in a primary or ultimate form, and beyond which, if they can be supposed to be subdivided, they must become something altogether different. In this respect, therefore, the views we have advanced accord generally with those at present entertained; and the only point in which they differ, is in supposing that the self-repulsive molecule, as it exists in the gaseous form, does not represent the ultimate molecule, but is composed of many of them. With respect to the nature of the ultimate sub-molecules of those bodies which we consider at present as elements, as, for instance, of oxygen, they may naturally be supposed to possess the most intense properties or polarities. Indeed such sub-molecules may be imagined to resemble in some degree the imponderable matters, heat, &c., not only by their extreme tenuity, but in other characters also; and this very intensity of property and character may be reasonably considered as one, if not the principal reason, why they are incapable of existing in a detached form. Lastly, are not these ultimate and refined forms of matter extensively employed in many of the operations of nature, and particularly in many of the processes of organization?

3. By supposing that these laws of combination are not confined to elementary bodies, but extend to all others throughout nature; and that bodies, however complicated they may be, always combine with reference to their volume in the gaseous state, and always act as simple molecules; we are enabled in some degree to explain that endless variety of property and condition which we see around us. For no sooner is a new compound molecule formed by an assemblage of similar molecules, than it may be supposed to be capable of combining with other molecules *chemically*, and of thus entering into a long and novel series of combinations; while these combinations again in their turn may be imagined to lead to others, and so on, till the variety becomes extreme. Indeed were not such combinations limited by the very nature of the things themselves, no two substances would probably possess the same properties. As it is, most of these compounds are incapable of separate existence; thus the compound super-molecules of water in the crystal of oxalic acid be-

fore referred to, are incapable of separate existence: if they could exist separately, would they assume the form of water?

4. It would not be difficult, though perhaps not very safe or prudent in the present state of our knowledge, to speculate on the crystalline forms assumed by different bodies, with reference to the principles we have advanced. We shall therefore not touch upon this part of the subject, further than by observing that the cohesive force, though supposed to possess some peculiarity as existing *among the molecules of different bodies*, is nevertheless essentially but of *one kind*. When therefore the molecules of different bodies are of the same size (or rather of the same weight,) they may be naturally supposed capable of associating themselves into the same form; and if they happen to be mixed together, they may even enter indiscriminately into the same crystal. Hence arises what has been termed *isomorphism* of bodies; while if there be a near approximation, but not an exact coincidence in the above relations, they may upon the same principles be supposed to give origin to *plesiomorphism*, that is to say, to a near approach to a similarity of form.

5. With respect to the nature of the circumstances which determine the peculiar characters and modes of existence of bodies we know very little. We are almost equally ignorant also of the nature of the causes which determine the cohesion of the molecules of bodies into the crystalline form. A variety of arguments might, however, be brought forward which appear to show that the size and shape of the molecules have a great deal to do with crystallization; certainly, at least, the molecules must be supposed to have a size and shape somehow or other adapted for the modes in which they are arranged, otherwise they could not be capable of such an arrangement. The cause of this similarity of size and shape is unknown, but it most probably depends upon the *similarity of weight (Isobarism)* of the molecule; that is to say, upon the *relation or identity of the absolute quantity of matter which the molecule contains*; which relation, as far as we can perceive, is not only the sole circumstance common to the molecules of different bodies, but that which of all others is the most likely to produce identity in the size and shape of these molecules.

6. When the molecules of bodies in solution do not happen to possess the requisite size and shape for cohesion, there is from the phenomena every reason to believe, that they occasionally possess the power, as it were, of making up the necessary form, by attaching to themselves the molecules of other bodies. Now, bodies so attached may be considered as acting a sort of complementary part; that is to say, they may be supposed to *complete* the figure or size of the molecule, so as to adapt it for combining in a certain manner. Thus the water of crystallization (and perhaps occasionally other matters) appears in the greater number of instances to perform an office of this kind, and to be in fact strictly comple-

mentary to that particular figure and size of the molecules, which may be supposed to be requisite for enabling them, not only to combine the more readily with each other, but at the same time, to form a symmetrical solid or *crystal*.*

One or two other circumstances connected with this part of our subject will be better understood after we have considered a little more in detail, the combinations of bodies with reference to their *weights*, and the absolute quantity of matter which they contain. To this most interesting inquiry, therefore, we shall in the next place proceed, confining ourselves, however, as before, principally to the elements of water, hydrogen and oxygen.

It has been found by experiment that the same volumes of different bodies in the gaseous state have very different weights. Thus for instance a volume of oxygen weighs sixteen times as much as the same volume of hydrogen. Hence as the number of self-repulsive molecules in each of these gases is presumed to be the same, the weight of the self-repulsive molecule of oxygen must of course be sixteen times greater than that of hydrogen; and GENERALLY, *the weights of the self-repulsive molecules of all bodies will be as the specific gravities of these bodies in the gaseous state, or will bear certain simple relations to these specific gravities*. This relation in *weight* among the molecules of bodies constitutes the basis of what is called the *Atomic theory*, proposed, some years ago by Dr. Dalton, who established the most important facts, that bodies do not, as formerly supposed, combine at random, but in definite proportions by weight; and if the preceding doctrines be well founded, it is evident they cannot combine otherwise.† As however water is composed of one volume of oxygen united with *two* volumes of hydrogen, the relative weights of the hydrogen and oxygen in water will be, not as 1 to 16, but as 1 to 8 only; while the weight of the self-repulsive molecule of steam will be 9. Hence, as one of the other of the elements of water is usually made the basis of the atomic numbers, this difference between the volumes and the combining weights of its elements has produced considerable confusion, and has given rise to much needless discussion. As a mere matter of convenience it is certainly preferable to consider the two volumes

* There is every reason to believe that one variety of isomorphism is effected on the principles here stated; and that the molecules of *different* substances, by attracting to themselves *different* quantities of water, or of other matters, may ultimately make up compound molecules similar to those of the bodies with which they may happen to be mixed, and may thus enter indiscriminately with these bodies into the crystalline form. Such a state of things is calculated to baffle the mere chemist, however expert; though it is probable, that if carefully examined and understood, an intermixture of this kind might be detected by the optical properties of the crystal.

† The reader is referred to "An Introduction to the Atomic Theory," recently published by Dr. Daubeny, Professor of Chemistry, at Oxford, for an interesting and able inquiry into the principles of this theory.

of hydrogen as one *atom*, (to use the language of Dr. Dalton), in which case oxygen will be 8, and water 9; but a strictly philosophical arrangement, supposing the principles we have advanced be well founded, would require that *the volume in all instances should be made the molecular unit*; in which case, the relative weights of the self-repulsive molecules of hydrogen and oxygen, as above mentioned, will be as 1 to 16.

In this country two volumes of hydrogen, as we have said, are usually considered as *one atom*, or unity, in which case oxygen is 8; but some have chosen instead of hydrogen, to make oxygen unity or 10, in which case hydrogen of course will be the one-eighth of 1 or of 10, that is to say, .125 or 1.25; and water, instead of 9, will be 1.125 or 11.25. It matters not which of these series of numbers, or whether any other be employed, so that the same relative proportions be observed among them; but the first series is that most generally adopted, and is upon the whole the most convenient. In the above manner the *atomic weights*, as they are termed, of all bodies capable of assuming the gaseous form can be easily obtained; but in those bodies that do not assume the gaseous form, in their simple state, but in some state of combination only, we are obliged to deduce the weight of the primary molecule from that of the compound. Thus carbon in its elementary state is incapable of assuming the gaseous form; but combined with oxygen it forms carbonic acid gas, one volume of which weighs 22 times as much as our standard two volumes of hydrogen. Now it has been found by other experiments, that of these 22 parts, 16 are oxygen. The remaining 6 must therefore be carbon; and accordingly 6 is the number upon our scale representing carbon, and the proportion, with reference to which, this body always enters into composition. In the case of bodies, as for instance, lime, which are incapable of assuming a gaseous form either alone or in combination, we are obliged to trust solely to analysis; thus common marble or carbonate of lime, as it is termed by chemists, is found to be composed of 22 parts of carbonic acid, and 28 parts of lime; 28 therefore represents upon our scale the atomic weight of lime, and so of all others.

It may be observed that we have spoken as if the atomic weights of bodies were related to one another by multiple; that is to say, were all multiples of some common unit. Now this opinion has been maintained by some, while it has been denied by others; who admitting that multiples in weight are necessary to the union of the *same* body, both *chemically* and *cohesively*, will not admit that they are necessary to the union of *different* bodies. The matter is one that in the present imperfect state of chemistry can hardly be determined by experiment; for what with the difficulty, or rather impossibility, of procuring bodies in a perfectly isolated form, and the unavoidable imperfections of all chemical processes, we can scarcely hope to arrive within the necessary limits of precision. If the above

views of molecular relations however, be well founded, it seems almost impossible to arrive at any other conclusion, than that the combining weights of all bodies are intimately related by multiple; though to enter further upon the subject here would be quite foreign to our present purpose.*

Lastly, it may be remarked that the numbers at present conventionally employed by chemists, to represent what have been called the *atomic weights* of bodies, are so convenient that they will not readily, nor indeed ought lightly, to be set aside; though there is reason to believe that many of them require revision, and are destined to undergo material alterations, even as the subject is at present understood. If the views however which we have advanced be correct, these numbers certainly do not represent nature; for as we have already stated, a strictly philosophical arrangement can be rationally founded only upon the volumes of bodies in the gaseous state, in which state some common volume in all instances should be considered as the molecular unity. Now, as in most instances, this molecular unity seems capable of subdivision, of course the number made to represent it can hardly ever be supposed to be a *prime* number. Hence, as combining molecules of bodies exist both below and above the molecular unity, they may often (perhaps always) be represented by a series. Thus suppose 9 to represent the molecular unity or volume of water, and that this be subdivided into 3 (which it is at least, and probably into a much greater number); the molecular combinations of water may be represented by the series, 3, 6, 9, 12, 15, 18, &c. We mean to say, the molecules of water as they actually enter into a combination in different bodies, may be supposed to be represented by these numbers; while, by way of distinguishing the different molecules, those below 9, may be designated generally *sub-molecules*, and those above *super-molecules*; and the molecular unity itself may be simply called the *molecule*, or in the gaseous state the *self-repulsive molecule*; distinctions,

* For the sake of those who are interested in such matters, one or two of the leading arguments may be briefly stated. We have rendered it probable that when two or more molecules of the same body combine *cohesively*, they form a compound, which though having properties in some degree allied to those of the original molecule, nevertheless usually possesses a specific difference, (that is to say, the *chemical* polarities of the compound molecule as modified by the union, will be different from those of the simple molecule). But a body possessing a *specific difference* may be supposed to be a *new* body, and thus capable of combining in future, *not* cohesively, but *chemically* with our original molecule. Now in such a case it is evident that the weight of the original molecule and that of the new compound molecule *must* have a certain relation to one another by multiple. If our space admitted, it would not, we believe, be difficult to point out instances of such combination among chemical phenomena; but we shall merely observe, that many of the substances at present considered as elementary, appear to be constituted upon the above principles from some common molecule of a still more elementary character. Moreover this law seems to hold universally throughout nature; and those substances related to the same molecule, in general constitute a natural group or family, having certain properties in common.

which for the sake of convenience, we have adhered to throughout these remarks, and which we have thought it thus necessary to explain.*

SECTION III.

General Remarks upon Chemical Compounds.

THE number of chemical compounds is so great that an attempt to enumerate them here would be quite out of place; we shall therefore content ourselves with stating, as briefly as possible, the general principles upon which these compounds are formed.

We have already pointed out many of the more remarkable compounds, when speaking of simple bodies; and in subsequent parts of this volume we shall have occasion to allude to others. In speaking of simple bodies we showed that by far the greater number of them occur in the metallic state, and are incapable of existence upon the surface of our globe, on account of the tendency they possess to enter into combination, particularly with oxygen. It would seem also from the intensity of the properties and the general incompatibility of the simple bodies with the present order of things, that their compounds, rather than themselves, were the objects the Author of nature had in view. Hence perhaps we are more immediately interested in the character of the compounds than in that of the elements themselves. Of the general nature of these compounds, the following observations, taken chiefly from Dr. Thomson's work on chemistry, will serve to convey some idea to the general reader.

THE COMPOUNDS which bodies form with one another are either PRIMARY OR SECONDARY. By PRIMARY COMPOUNDS are usually understood those which are formed by the combination of two or more simple bodies with each other; while by SECONDARY COMPOUNDS are meant the compounds formed by the union of the primary compounds with each other.

The PRIMARY COMPOUNDS naturally divide themselves into three grand classes, viz. *acids*, *alkalies* or *bases*, and *neutrals*; on each of which we shall make a few remarks.

Of Acids. Formerly it was considered as requisite that bodies, in order to belong to the class of acids, should have a *sour* taste, should be soluble in water, and should have the property of reddening vegetable blue colours: and these properties do indeed belong to some of the most common and powerful acids. But there are

* The above terms are to be considered as a temporary expedient only. If these views be established it will not perhaps be difficult to devise hereafter both a notation and a nomenclature founded upon them. At present such an attempt would be ridiculous.

various acids which have no taste, which are not soluble in water, and some which are incapable of altering the colour of the most delicate vegetable blues; hence the term *acid*, as at present employed by chemists, is understood to denote a substance which has the property of combining with, and neutralizing, alkalies or bases. The celebrated Lavoisier endeavoured to prove that oxygen constitutes an essential ingredient of all the acids; but later observations have shown that not only oxygen, but the analogous principles, chlorine, bromine, iodine, and fluorine, are also capable of forming acids by uniting with several of the acidifiable bases. Still more recently, certain compounds of cyanogen, (a primary compound of carbon and azote,) of sulphur, of selenium, and of tellurium with the acidifiable bases, have been ranked among the acids; so that the acids at present known may be divided into nine classes, viz. *oxygen acids*, *chlorine acids*, *bromine acids*, *iodine acids*, *fluorine acids*, *cyanogen acids*, *sulphur acids*, *selenium acids*, and *tellurium acids*.

The *oxygen acids* are more numerous and better understood in general than the other classes; they may be subdivided into two kinds; those with a single base; and those with a compound base. The acids with a single base amount to between thirty and forty, and include most of the best known and most important of those used in chemical processes and in the arts; such as *carbonic acid*, *sulphuric acid*, *phosphoric acid*, *nitric acid*, &c. The oxygen acids with a compound base are chiefly derived from the vegetable or animal kingdoms; they are still more numerous than those with a single base, the number at present known amounting to upwards of sixty; as instances may be mentioned the *tartaric acid*, the *citric acid*, the *malic acid*, the *lithic acid*, &c.

The *chlorine acids* are perhaps as numerous as those containing oxygen, but they have been much less studied, and are, consequently, much less understood. One of the most familiarly known belonging to this class is the *muriatic* or *hydrochloric acid*, which is composed of chlorine, united with hydrogen: and here may be noticed a remarkable circumstance, that not only chlorine, but all the other allied principles, when they combine with hydrogen, form powerful *acids*; while the compound of oxygen with hydrogen, as we have formerly noticed, is *water*, a substance altogether dissimilar. Such is the wonderful and inexplicable nature of chemical combinations!

The *acids* containing *bromine*, *iodine*, and *fluorine*, are still less satisfactorily known than those containing chlorine. As just observed, the acids formed by these different principles with hydrogen, viz. the *hydrobromic*, the *hydriodic* and the *hydrofluoric acids*, possess the most decided properties and are best understood.

The *cyanogen acids* are numerous and important, as most of them are poisonous; thus the compound of cyanogen and hydrogen (analogous to those above mentioned) is the *hydrocyanic*, or *prussic acid*,

one of the most virulent poisons in nature, and instantly fatal to organic life in every form.

Of the remaining acids, the *sulphur acids* the *selenium acids*, and the *tellurium acids*, we know very little. Those with which we are at present best acquainted are analogous to the preceding acids, and are formed by the union of the different principles with hydrogen. These acids were formerly known under the names of *sulphuretted*, *seleniated*, and *telluretted hydrogen*; but some chemists have now given them new names conformably to the above nomenclature.

Of alkalies and bases. Bodies of this class, are, like the acids, composed of different elementary principles, and particularly of certain metals, combined with oxygen, chlorine, &c., but usually in less proportions than in the acids. Hence the alkaline bases are as numerous as the acids, and may be divided in a similar manner into *oxygen alkalies*, *chlorine alkalies*, &c. Of these the *oxygen alkalies* are by far the best known and most important, and they may, like the oxygen acids, be subdivided into two kinds, viz. those with a single base, and those with a compound base. The alkalies with a single base include all the well known common alkaline bodies, *potash*, *soda*, *lime*, *baryta*, &c.; while the alkalies with a compound base are chiefly from the vegetable kingdom, and comprehend the newly discovered alkaline matters, so successfully introduced into medicine; such as *quinine*, from bark, *morphine*, from opium, &c., the composition of which at present is not well understood. *Ammonia* or the *volatile alkali*, may perhaps be referred to this class of alkalies; though its composition as consisting of hydrogen and azote only, without oxygen, may be considered as constituting an exception or anomaly.

The other *alkaline* bodies into which *chlorine*, *iodine*, &c., enter, are very little known, and some perhaps may be even inclined to doubt their existence.

Of neutral compounds. These are arranged by Dr. Thomson, under seven heads, the mere naming of which will probably be all that is required, to convey to the general reader a sufficient notion of their nature. They are *water*, *spirits* or *alcohol*, *ether*, *ethyl*, (a peculiar oily substance obtained from spermaceti) *volatile oils*, *fixed oils*, and *bitumens*.

Such is a summary of the PRIMARY COMPOUNDS and of the principles upon which they have been most recently arranged. We come now to consider briefly

The SECONDARY COMPOUNDS, or those formed by the union of the primary compounds. As the neutral primary compounds (if we except water) enter into few combinations, it is obvious that the SECONDARY COMPOUNDS must consist chiefly of substances formed by the union of the other two general classes of bodies, namely, of *acids* and *alkalies*. These SECONDARY COMPOUNDS are usually denominated SALTS; they constitute a very numerous and most important class of

bodies; and as resulting from the mutual union and saturation of all the different principles capable of combining with each other, they of course are more abundant than any other bodies; indeed, the surface of our globe, may in a great measure, be considered as made up of them. The term *salt* was originally confined to common salt; but by a singular fate, this body, as being composed of chlorine and sodium only, is now excluded from the class of salts: salts being, as we have just said, considered by chemists, to be formed by the union of acids and alkalies only. As there are nine classes of acids of course there must be as many classes of salts; of these, the *oxygen acid salts* are by far the best known and the most important; and, indeed, this class includes the greater number of those salts employed by chemists or in the arts. If these salts be arranged according to their bases, which perhaps upon the whole, in the present state of our knowledge, is the best mode of arranging them, they will be found to constitute upwards of fifty genera; and if we consider that each of these genera includes, in most cases a great number of species, we may form some idea of the wonderful variety of bodies existing in nature, and with the properties of which the chemist is required to be conversant. Familiar instances of the oxygen acid salts are *nitre, common chalk, gypsum*; various metallic salts, as the *white, green and blue vitriols, &c. &c.*

Of the *chlorine* and the *other classes of salts* very little is known, and this little is chiefly confined to the salts composed of these principles and of hydrogen. The hydrochloric or muriatic acid combines with ammonia, and forms the well-known compound *sal-ammoniac*, a salt supposed to be a true *hydrochlorate* or *muriate*. But this is the only instance known; and in all other analogous instances, the hydrogen of the hydrochloric acid and the oxygen of the base, unite to form water, which is separated or separable; and thus the chlorine and the metallic base are left in union by themselves in the state of a *chloride*. This is the case, for instance, with *common salt*; which, as we before said, is in reality a *chloride* of *sodium*, that is to say, a simple compound of chlorine and the metal sodium. Similar remarks appear to be applicable to the other analogous compounds. It must be confessed, however, that our knowledge with respect to all these matters is at present in a very unsatisfactory state, and is probably destined at no very distant time to undergo a complete revolution.

SECTION IV.

Recapitulation. General Reflections on the Subjects treated of in the preceding chapters.

THE subjects considered in the present chapter may be viewed as a continuation of what has engaged our attention in those that have preceded; and the principal circumstances detailed may be thus recapitulated.

1. All perfectly gaseous bodies combine with reference to their volume; that is to say, any volume or bulk of a gas always combines with an equal volume or bulk of the same or of another gas; or with a volume having some simple relation to its own volume, as half, or twice as much, &c.; and not with any intervening fractional part of a volume.

2. The same volume of different gaseous bodies has very different *weights*: hence on the supposition formerly advanced, that all perfectly gaseous bodies under the same pressure and temperature contain an equal number of self-repulsive molecules, the molecules of different gaseous bodies must also have different weights; which weights will be as the specific gravities of the gases, and may be represented by numbers proportional to these specific gravities.

3. From the above relation between the volumes and the weights of bodies in the gaseous state, it follows, that *all bodies must combine with reference to their weights*; that is to say, that the same weight of the same body (or half or twice as much, &c.) must always combine with the same weight (or half or twice as much, &c.) not only of the same, but of every other body.

4. The numbers representing the relations among the specific gravities of bodies in the gaseous state, are called the *molecular* or *atomic weights* of the different bodies.

Such is the foundation of what is usually called the *Atomic Theory*: the principles of which are generally admitted as regulating chemical combinations.

We shall now conclude the present Treatise on chemistry with a few remarks more especially relating to the object of these volumes. And here, it may be observed, once for all, that throughout the preceding pages, as well as in what follows, we have endeavoured to state each argument as distinctly as possible, without encumbering it too much with details—in short, to illustrate principles rather than to enumerate particulars. When the principles of a cumulative argument are understood, the details are readily supplied by the reader.

First. On taking a general and collective review of the facts

brought forward in the preceding chapters, the circumstances calculated to strike our attention in the first place, are the wonderful coincidence between the priority of existence, and the universal prevalence of the primordial agents and elements of nature, on the one hand; and on the other, the beautiful adaptation of the agents and elements of a later and more subordinate character to these primordial principles; so that when the whole are taken together they constitute one harmonious and connected series, in which all the various parts are mutually adapted and dependent. In the following chapters we shall have occasion to notice many of the more important of these subordinate arrangements; at present we shall chiefly confine ourselves to a general review of what has been already stated.

We are told by the inspired historian that after matter had been created and endowed with motion, the next Almighty fiat was "let there be light;" and if we suppose this fiat, to have included the other imponderable forms of matter, heat, &c., how entirely do the whole phenomena of nature accord with the sacred narrative? Light, and probably its attendant heat, are the most generally diffused and universal of all the subordinate agencies; so much so, that they are not confined to our globe or even system, but extend throughout the universe. Their laws and influences, therefore, seem to be as general and as necessary to the present order of things, as those of gravitation itself. The priority of existence also of light and of heat is self-evident; for until they existed, nothing else, as we are acquainted with things, could have had existence. Now all subsequent creations have been made with the most exact regard to the influences of these prior agencies. The globe, for example, which we inhabit, is at a certain distance from the sun, the great centre of our system and of light and of heat; and where of course, according to the laws which light and heat obey, they must act with a certain intensity. Hence it was necessary that the materials of this globe should have a certain degree of fixity, otherwise they could not exist. If indeed there had been no ulterior views, with respect to the destination of this globe; all that would have been requisite, would have been to have made it sufficiently firm to move through space; and for this purpose the more homogeneous and compact its composition had been the better. But what are the facts? Our globe, though stable, so far from being homogeneous, is composed of a variety of substances all differing from each other in their properties; some being solid, some fluid, some aeriform under the common circumstances in which they have been placed, and all beautifully adapted, both by their physical and chemical properties, to the purposes they fulfil in nature; and what is more, to the purposes they were *designed* to fulfil in nature; for on no other supposition would their properties be intelligible.

Thus water, *within very narrow limits of temperature*, is a solid, or a liquid, or a gas; and yet these *very narrow limits of temperature*, neither more nor less, are precisely those which exist upon the surface of our globe; where they are the natural and necessary results of its situation in the universe, and of the general laws which govern the distribution of light and heat. Had the properties of this body been other than what they are, or had the general temperature of our globe been different, water would have existed altogether in the solid or in the gaseous state, and its most important properties would have been unknown. Hence it seems almost impossible to arrive at any other conclusion, than that the temperature of the earth, and the properties of the water on its surface, have been mutually adjusted to each other. And further, since the temperature of the earth, as just stated, is the natural result of the general laws which govern the distribution of heat and of light; the inference must be, that the properties of the water, as the subordinate and later principle, have, at an after period, been adjusted to the prior temperature of the earth.

If we do not admit of this adjustment, we must suppose that the whole has been the result of chance, or of some other unintelligent principle; and if water had been the only principle in which such adaptations were apparent, the supposition of chance might, perhaps, be received; at least it would have been difficult to prove the contrary. But when we see similar happy adjustments in every object around us,—in the different elements of the air we breathe, the soil we tread upon, the rocks in all their varieties, composing the solid crust of our globe, not one of which could have been more happily contrived for the purposes they fulfil, nor indeed be scarcely conceived to exist otherwise than what they are, without destruction to the whole of the present arrangements—when we see all these things, and duly reflect upon them, it becomes absolutely impossible to admit that so much happy adjustment, so much apparent intelligence, so much, in short, of what the veriest sceptic under other circumstances would have allowed to have been evidences of design, can be evidences of anything else than design, or have resulted from any unintelligent cause whatever. Hence we are driven irresistibly to the only rational conclusions which the premises appear to admit of, viz., that all these happy adjustments and adaptations which we see in nature, are really and truly what they appear to be,—so many evidences of design; and, consequently, that the whole have sprung from the will of an intelligent and omnipotent Creator.

The above inferences are deducible from the plain and obvious arrangements of nature, which every one can readily understand: but when speaking of elementary bodies we remarked, that in a variety of instances, their object and use were unknown to us; and

before we quit this part of the subject, it may not be out of place to consider briefly these difficult points.

When we see adjustments so wonderful, and such wisdom displayed in those parts of creation which are intelligible to us, we cannot imagine that the Being who made them all would act otherwise than with wisdom. Hence what we do not understand, or what may appear incongruous to us, we naturally and properly refer to our own ignorance. The phenomena of chemistry are so extraordinary and often so unexpected, that little in general can be predicated of them, beyond what is actually known. The most experienced chemist, therefore, as compared with the Great Chemist of nature, is immeasurably deficient; and can only contemplate His wonderful operations with astonishment and awe, and own them unapproachable. Who then can tell what design is latent under *apparent* incongruities? What elaborate contrivances and adaptations may have been requisite to have produced water or carbon, or any other essential principle, out of the materials and in conformity to the laws, by means of which the Great Author of nature chose to operate? Who can tell that the minor evil may not have been essential to the existence of the greater good? That the poisonous metals, for instance, are not, as it were, the refuse of the great chemical processes by which the more important and essential principles of nature have been eliminated? That these poisonous principles have not been left with such subdued properties as scarcely to interfere with His great design,—not because they could not have been prevented—not because they could not have been removed—but on purpose and designedly to display His power?

Secondly. If we pursue the subject a step further, and inquire into the means by which all the beautiful adaptations we have been considering are effected, we shall find that they principally depend upon a certain due adjustment to each other of the *qualities* and *quantities* of the different substances, and more especially of the different elementary principles, of which our globe is composed. These adjustments are so universal and so varied in their character, that to enumerate them all, would be little else than to enumerate all the objects in nature; we shall therefore content ourselves with a few of the most familiar of each kind.

In the first place, with respect to the adjustment of *quality*. Let us consider for a moment and by way of illustration, what would happen if the qualities of water or of air were to undergo a change: were, for example, the important fluid water to become sour or sweet, or heavier or lighter, or indeed anything but what it is; or were the air of the atmosphere to acquire odour or colour, or to become opaque: by either of such changes, slight as they appear, the whole of the present economy of nature would be deranged. Again, if the qualities of the acid existing in the common salt of the ocean were to become so modified as to quit the alkali with which it is at

present associated, and to combine with the limestone composing our rocks; while the carbonic acid, thus set free, was diffused through the atmosphere: in such a case a large part of the solid crust of our globe would rapidly disappear and become dissolved in the waters of the ocean, which would thus be totally unfitted for their present purposes; while the liberated carbonic acid would instantly prove fatal to animal life. Such would be the consequences of these trifling changes in the qualities of a few substances only: nor is it possible scarcely to conceive any other change that would not be attended with similar results.

In the next place, the importance of the adjustments of *quantity* is equally striking. Let us, for instance, conceive what would happen from the simple inversion of the quantities of dry land and of sea as they now exist: in such a case there would not be enough of water to preserve the surface of the land in a moist state, and the greater part would be in the situation of the deserts of Africa, and totally unfit for the habitation of organized beings. When speaking of the elements of water, we alluded to the happy adjustment of the quantities of oxygen and hydrogen in the world; and to the consequences that would have ensued if hydrogen, instead of oxygen, had predominated. The same remarks apply to almost every other element; for example, had the proportions of chlorine, and of the soda in common salt; or of the carbonic acid, and of the lime in our marbles, been anything but what they are, the one or the other of the ingredients must have been in excess, and the present order of things could never have existed. Again, were gold suddenly to become as abundant as iron, and iron as rare as gold; were the carbon existing in the present useful form of fossil coals, to assume the crystallized form and become diamonds; the whole order of nature would be subverted, and the whole of the present arrangements be involved in ruin. Those who deny the argument of design, of course, consider such suppositions as these absurd; and if carried too far, they doubtless, under any circumstances, lose much of their effect; but admitting the argument of design, the judicious application of such suppositions is well calculated to place the advantages and effects of certain arrangements in a more striking point of view than can be obtained by any other means. More especially, such suppositions, by showing the wonderful adaptations of subsequent creations to prior existences, are admirably calculated to illustrate the fitness, and consequently the *apparent* design displayed in the formation of these prior existences; and thus to show that they must have been created with reference to ulterior purposes.

The argument of prior arrangements and the subsequent adaptation to these arrangements of other creations is one of such interest, and its consequences are so important, that perhaps it may not be deemed irrelevant if, for further illustration, we recapitulate the principal points in a condensed form. For this purpose we

shall select the obvious and familiar relation between water and air, and plants and animals.

The prior existence of water and air as compared with that of plants and animals, is established by the fact, that water and air *can* exist without plants and animals, but that plants and animals *cannot* exist without water and air. Hence as water and air must have existed with all their present properties before plants and animals were created, the question naturally arises, how water and air came to be endowed with their present properties? *We* suppose that water and air were created with their present properties, with reference to the future existence of plants and animals; and on this supposition the whole becomes intelligible. Further, that this is the true explanation, and that water and air have not obtained their present properties by chance or accident is rendered still more probable by the following considerations. We have said that water and air can exist without plants and animals; now as far as we know, water and air might have existed *for ever* without plants and animals; at least the contrary cannot be proved or even rendered probable. Moreover, plants and animals, as involving new principles of a higher order (those of life), never could by any law of nature, necessary or probable, have resulted from an inferior agency. Hence there is no necessary relation of cause and effect between the prior existence of water and air, and the subsequent existence of plants and animals; as some seem to have supposed. Hence too it follows irresistibly, that plants and animals have been created, and their properties adapted to those of water and of air at some subsequent period, and by some external and superior agent. But the agent that could thus create plants and animals, could surely have created the water and air likewise; nay, *must* have done so; for, as the prior and subsequent creations taken together, evidently form but different parts of one and the same general design, the whole design must have been the work of one and the same intelligent Agent.

It yet remains to draw the attention of the reader to another circumstance connected with these adjustments in quality and quantity, viz. the *double* adjustment. Of the causes of the qualities of bodies we know but little, and that little is founded solely on experience. We see that these qualities are admirably fitted for their apparent purposes, and hence (as they might have been different), we arrive at the probable conclusion that they have been so fitted by design. The collocation of quantities and numbers, exactly where they have been required, adds much to the probability of this conclusion; as such a collocation could hardly have been other than the act of an intelligent Being. But the *double adjustment in quality and quantity of the same thing at the same time*, adds almost infinitely to the weight of evidence; and indeed furnishes a proof in favour of design and of its consequences, which amounts to all but actual demonstration.

Thirdly. There is another point of view in which we may consider what has been stated, and by which we shall at the same time be brought a step nearer to the existing order of things. Amidst all that endless diversity of property, and all the changes constantly going on in the world around us, we cannot avoid being struck with the general tendency of the whole to a *state of repose or equilibrium*. Moreover, this tendency to equilibrium is not confined to the ponderable elements, but prevails also in the same striking degree among the imponderable agencies, heat and light; which as we have seen, cannot be anywhere long retained in a state of excess, on account of their natural disposition to acquire a certain state of equilibrium; depending generally upon the place of the earth in the solar system. Now, the formation of this state of equilibrium, and its preservation, may be considered as the results of those wonderful adjustments among the qualities and quantities of bodies above alluded to—the qualities being such as to neutralize each other's activity, while the quantities are so apportioned as to leave one or two only predominant.

The preceding is a general view of the subject. But it is to be observed, that the state of equilibrium here described is not absolutely *fixed*; as such an unyielding condition would be not less incompatible with the present order of things than a condition of unlimited change. The whole are so adjusted, therefore, that slight deviations, or oscillations about the neutral point of rest or equilibrium, take place, and are even necessary, as the world is at present constituted; though these changes are bounded within very narrow limits, and greater deviations would instantly prove fatal to the whole. If we inquire into the principles upon which these slight deviations take place and are regulated, we shall find still further reason to admire the wonderful arrangements displayed. When speaking of the elements of water, we observed how much the stability of nature depended upon the proportions of the elements of this fluid; and that one of its elements, oxygen, existed in excess, and in a free state, in the air. Now, it is to the agency of this oxygen in a free state, and to the annual and diurnal motions of the earth, that most of the minor operations going on around us are to be referred. The universal presence and peculiar properties of oxygen are such as to interfere more or less with everything; while the motions of the earth keep everything in a constant state of activity and change. Yet, the general tendency of the whole, as before observed, is towards a state of equilibrium; and the principles upon which this tendency operates, are very intelligible. Thus all bodies *below* the neutral point of rest, if we may be allowed the expression: that is to say, all bodies of a marked elementary character, have a tendency to combine with each other *synthetically*; while *beyond* the neutral point, bodies have very little tendency to combine further; and if by intention on the part of the operator, or from any other cause,

they be so made to combine, when left to their own operations, they speedily revert or oscillate back to the point of equilibrium.

Such are the means by which the state of equilibrium we are considering has been produced, and by which it is still preserved; nor is it possible to reflect upon the subject for a moment without arriving at the conclusion, that this state of equilibrium possesses all the characters of a prior arrangement, to which organized beings have been subsequently adapted. We are thus led, in the next place, to make a few remarks upon the subsequent adaptation of organized beings to the pre-established equilibrium of nature.

The present races of organized beings in all instances are produced only by the process of generation; and if they were annihilated, there are no natural operations going on in the world, which can lead us to believe, that by any law of nature such organized beings could be reproduced. That is to say, we cannot conceive that hydrogen, carbon, oxygen, and azote, with heat and light, &c. from what we know of their properties, would ever be able, of their own accord, so to combine as to form a plant or an animal. Hence, when plants and animals were first produced, it is evident that there must have been a power or agent in operation, which has long since discontinued so to operate; and that this power or agent not only created plants and animals; but at the same time imparted to them a capability of perpetuating their existence, for a period, at least, commensurate with that state of equilibrium in which they have been placed. Now, whether we consider the power or agent who accomplished all these things, to have been the Deity himself operating immediately, which is most probable; or whether we consider with some, that He operated by delegated agencies and laws, the result is the same as far as our argument is concerned; the object of which argument is to show, that the present races of organized beings are somehow or other influenced by the same general laws which appear to regulate inorganic matters. That is to say, organized beings at the present time, are at least as fixed and permanent in their nature, as the state of equilibrium in which they have been placed; and consequently no new plants or new animals can, as the world now exists, be imagined to be produced without a new and specific act of creation; or at least, without an entire change in the standard of equilibrium.

We have alluded to the commencement of the present order of things, and to a possible state of change in the condition of equilibrium: perhaps it may not be amiss to make a few further remarks upon these points. That the present order of things most certainly has had a beginning; and as certainly will come to an end, we cannot doubt; the questions are, when was this beginning; when will be this end? Of the end of course we can know nothing: the beginning is less obscure; and there are indelible impressions left upon the materials and structure of our globe, which throw no ordi-

nary light upon this question. The consideration of the changes which our earth has undergone, however, belongs to another department: we shall only observe that these changes appear to be of two distinct orders, which have alternated with one another in succession. The first of these orders of changes seems to have been of a slow and gradual kind, and such as might be supposed to take place during a state of things, more or less like the present, and existing for a considerable period. The changes of the second order, on the contrary, have evidently been violent, sudden, and disruptive, of comparatively short duration, and differing exceedingly in degree and in extent. In general they appear to have operated from within; but whether altogether from internal or from external influences, is unknown to us. Now, it is remarkable that these successive alternations seem each time to have changed the standard of equilibrium; and that during the state of comparative quietude, or the interval of equilibrium between the convulsions, organized beings have existed, adapted to the exigencies of that particular state of equilibrium; and which beings must have been successively created: moreover, the later creations gradually approach to those at present in existence. Hence, the change in the standard of organization seems to have been not only simultaneous with the change in the state of equilibrium; but doth appear to have been progressively raised after each convulsion. Finally, the last general catastrophe of the disruptive order was evidently a deluge.* Such are the conclusions which geologists have deduced from a careful survey of that part of the crust of the earth to which they have access; and these conclusions are of the most important kind. In particular, by demonstrating the existence of successive adaptations to different successive states of equilibrium, they place the argument of design in a new light, and add in no small degree to its force. This part of the subject, however, belongs to the geologist, to whom, for the present, we shall leave it.

Fourthly. The argument of design as connected with the subject of equilibrium above treated of, may be considered yet in another point of view. In this state of equilibrium we have observed that the properties of bodies, as they actually exist around us, are all so sub-

* If we judge from what we see going on in nature around us, and from the little tendency there appears to be in things at present to combine into new forms, we must be almost led to the conclusion that the development of new elements, as well as of new agents, is necessary to produce new and specific arrangements. May we not then infer that during those periodic convulsions alluded to in the text, new elements have been developed, or old ones decomposed into others of a higher and more elementary kind; and that in virtue of the general laws in operation, these new elements have subsequently combined to form series of new arrangements? Of course this supposition is intended to apply only to the *means* adopted by the Deity to effect his purpose. The formation and selection of these new elements must in all instances be supposed to result immediately from his will and agency.

duced and passive in their character, that no one predominates over, or excludes the other. Now, when we reflect that almost all these bodies are *compounds*, and when we compare the properties of these compounds with the properties of the elements composing them, it is impossible not to infer, that the properties of the compounds rather than those of the elements, were, at their origin, the objects contemplated. That is to say; in order that the compounds might be perfect, the elements calculated to produce them, were created essentially such as these compounds might require, without reference to the secondary properties of the elements themselves; which were left to be determined as the more general laws of matter might decide. For instance, the properties of hydrogen in water, and of chlorine and sodium in common salt, not being required in the economy of nature, the properties of these elements have not been made compatible with organic existence; and the whole attention (if such a term may be applied to the operations of the Deity) has been directed to the properties of the compounds, water and salt. Thus, on the one hand, where required, we have the most striking adaptation of property; while on the other, where *not* required, this adaptation of property has *not* been attended to: nor is this true of water and salt only, but of almost every other compound in nature. Nay, what is more, the incongruities of the whole system have, with the most consummate skill, been thrown, as it were, among those properties *not* required. Hence the arrangements of nature viewed in this light, not only exhibit novel evidences, but some of the most striking evidences of design that we possess.

The subject of the incongruous properties of bodies is one of great interest. We have seen that many of the elementary principles are poisonous; and that almost all of them, if liberated from their affinities, and sent abroad into the world, like so many demons let loose, would instantly bring destruction upon the whole fabric. Now, why should such incompatible properties be necessary to the properties of the compounds? Why, for instance, should the incombustible fluid water contain one of the most combustible principles in nature? or the mild and innocuous common salt be composed of two elements, which, in their separate state, would instantly destroy life? Why, do we repeat, are these deleterious properties of the elements necessary to the wholesome condition of the compound? What part do they perform; or what property do they contribute to, or represent? These are questions utterly beyond our comprehension, and are likely always to remain so. That these incompatible properties of the elements, however, do, in some way, contribute to the perfection of the compounds, we cannot doubt; and the only grounds upon which such incompatibility seems to admit of explanation is, that it results necessarily from those limitations which the Deity has thought proper to prescribe to his power, and to which he always most rigidly adheres. Moreover, be the reason what it may, it is

evident that these arrangements, so immediately calculated to lead to practical difficulties, have been the result of *choice*. For we cannot but believe that an omnipotent Creator, if he had so willed, could have made the elements innocuous, as well as the compounds; nay, to our limited understanding this would have been the easiest and most natural mode of proceeding. Why then did he choose the apparently more difficult course? Why, to use the language of Paley, but "that he might let in and thereby exhibit demonstrations of his wisdom." Throughout nature, the exigencies and incongruities necessarily arising from the arrangements we have been considering, have given occasion for the display of the most astonishing wisdom and power. And instead of that jarring and clashing which might have been expected from so many conflicting elements, the qualities and quantities of these elements have, upon the whole, been so wonderfully adjusted to each other, that they neutralize and balance each other's evils; and the general result has been, that all have finally settled down together into that harmonious state of equilibrium before alluded to, so admirably adapted for the existence of organic life.

Fifthly. We have hitherto confined our attention to general principles and arrangements; but the commonest chemical process may be made to furnish us with some striking proof of the omnipotence of the great Creator. Let us, for example, consider what happens in a simple and familiar instance of chemical decomposition; as when a solution of lunar caustic (nitrate of silver) is added to a solution of common salt. In this case, the chlorine of the salt combines with the silver, and produces a curdy precipitate which falls to the bottom; while the nitric acid combines with the soda, and forms a soluble salt which remains in solution. Now, we showed in a former chapter, that the minutest fragment of matter appreciable by our senses, consists of innumerable molecules. If therefore we suppose a small quantity, as an ounce, of the lunar caustic, and a proportionate quantity of common salt, to be mixed together; what countless myriads of molecules, in a portion of time literally inappreciable, must have sought out, and combined each with its fellow, in this simple process! The human mind absolutely recoils from the contemplation of objects so completely beyond its powers; for the utmost that we can imagine, must fall almost infinitely short of the reality. Were we, for illustration, to conceive every human being at present in existence, to be collected together into one vast array, and to be all dressed exactly alike, and to perform the same military manœuvre at the same moment; we should be probably as far short of the actual numbers of similar molecules, each manœuvring exactly alike in the above simple experiment, as a single company falls short of our congregated army! Again, to take another familiar illustration, as the working of a common steam engine: we are assured that in this simple operation, there are more self-repulsive

molecules of water always constantly engaged, and conspiring to the same end, than there are of quadrupeds in existence upon the whole surface of the globe! The above are designed to illustrate the principles of the argument only: the argument itself, like all the preceding, is strictly accumulative, and applies more or less to every operation in nature.

Such is a summary sketch of the wonders developed by chemistry; and what an idea do they convey to us of the wisdom and of the power of Him who contrived and made the whole! Of the *capacity* of that eternal Mind, who while he directs the universe, at the same time takes cognisance and regulates the movements of every individual atom in it! To whom the inmost nature, and end, and object of every part are familiar; and of whose comprehensive designs the whole forms but a single link, the antecedent and the consequent to which are merged alike in infinity!

In the preceding pages we have pointed out a few of those wonderful arrangements, which to common understandings appear to indicate design, and consequently to prove that such arrangements are the works of an intelligent and omnipotent Creator. There are, however, some minds so obtuse, or so strangely constituted that they either cannot, or will not admit the force of these arguments, and who consequently deny the evidences of design altogether. The consideration of this part of the subject properly belongs to another department, to which the reader is referred for details; we shall therefore confine our observations to a brief recapitulation of the leading objections to design, and offer such answers to them as are more immediately furnished by our own subject.

The objectors to the argument of design may be divided into two classes; those who denying a First Cause, affect to believe that all the beautiful adaptations and arrangements, we see around us, are the result of what they call the "necessary and eternal laws of nature," and who in fact are Atheists, or rather Pantheists, "to whom the laws of nature are as gods;" and those who, without denying a First Cause, contend that design cannot be *proved*; that the arrangements of external nature, as they appear to us are little more than mental delusions; and that things appear congruous and adapted to us, however incongruous they may be in reality, simply because we have nothing else than our own intellects with which to compare them.

To the first class of objectors, we may thus briefly reply. The "laws of nature," or rather our knowledge of them, may be considered as of two kinds; First, laws founded upon *reason* or necessity, the phenomena regulated by which laws we cannot conceive to be otherwise than what they are; and laws founded upon *experience*

only, among whose dependent and sequent phenomena we can discover no necessary relation whatever. Now, few, if any, of the "laws of nature" can be *proved* to belong to the first kind; we know, for instance, no reason or necessity why hydrogen, carbon, oxygen, and azote *must* combine to form plants and animals; we only know that they *do* so combine, but why and how we know not. Hence, as the Atheist cannot *prove* his "laws of nature" to have a *necessary* existence, he has no right to make the assumption. On the other hand, he cannot prove these laws to be *eternal*; for *experience*, the sole ground upon which his knowledge of them is founded, is decidedly hostile to this supposition, as we have in the next place briefly to show.

In reasoning from cause to effect in matters of experience, two conditions at least are requisite; first, the effect must be *possible*, that is to say, must not be opposed in any way to the cause, or to the facts of the argument; and secondly, it must be *probable*, or in other words, the effects must accord and harmonize generally with the accompanying phenomena. But the atheistical doctrine of the "eternal laws of nature" seems to us to violate one, if not both these conditions. In the first place, as to the facts, or *possibility* of the case. We have seen, that a very superficial observation of the world as it exists, and as it obviously has existed within the limits that its history can be traced, is sufficient to show, that its course at all times has been progressive. That is to say, the world itself before arriving at its present condition, has not only undergone a progressive series of different states; but in these different states, *different* "laws of nature" have prevailed. In the second place, putting the previous history of the world out of the question, and judging solely from what we see around us, it appears *improbable* in the highest degree, that the present variable and *finite* order of things, should constitute a term or link of a uniform and *infinite* progression. The notion therefore that the "laws of nature" have existed as they now exist from eternity, if not actually *impossible*, is so exceedingly *improbable*, that it cannot be admitted for a moment. Hence as these laws cannot be proved to have a necessary existence, or to have existed from eternity as they now are; it becomes more than probable that they have had a beginning; and thus the inference of a pre-existent Law-maker, and all its consequences are at once inevitable.

We come now to consider the second class of objections to the argument of design; those namely, which are founded on the grounds that design cannot be *proved*; and that what we call design is little more than mental delusion. We admit at once that everything we know of external nature we know from *experience* only; and consequently we admit that what we call design in external nature is only *very probably* design; that is to say, cannot be *proved* to be design by any argument founded on *reason or necessity*.

But having made this admission, we assert upon the self-same grounds, that our opponents cannot, by any argument founded on *reason or necessity*, prove that what we call design, is *anything else* than design; that is to say, is *not* design. Now until this be proved the force of their objection may be considered as completely neutralized; while the objection itself becomes thus reduced to the condition of a mere sophism, that leaves everything precisely in the same state as it was at the beginning.

Having thus briefly disposed of these objections to the argument of design, we finally recur with pleasure to that *common-sense* view of the subject which we have already contended for, and which we still maintain, viz., that design is independent of the designer; in other words, that design is design, whether exemplified in the works of man or in those of his Maker—a view which has been adopted by the wise and good in all ages—which has all the probabilities on its side, and which alone, of all others, points out to man his true and natural position among created beings. When man, indeed, compares himself with the universe, his own insignificance appears quite overwhelming; but the argument of design assures him that, insignificant as he is, while he investigates and approves of the order and harmony around him, he is exerting faculties truly god-like—that his reason though limited in degree, must be immortal in kind, and thus differ from that of the great Architect of all, only in not being infinite. And hence the proud relationship in which man justly considers himself to stand with respect to his Maker! hence the grand source of that longing after a future state, where his knowledge will be consummated, and where he will no longer “see through a glass darkly”—notions at once the result and reward of his reason, and which raise him far above all other animals.

BOOK II.

OF METEOROLOGY: COMPREHENDING A GENERAL SKETCH OF THE CONSTITUTION OF THE GLOBE; AND OF THE DISTRIBUTION AND MUTUAL INFLUENCE OF THE AGENTS AND ELEMENTS OF CHEMISTRY IN THE ECONOMY OF NATURE.

IN the foregoing chapters, we have endeavoured to convey some idea of the "limits which the Deity has been pleased to prescribe to his own power;" or in other words, of the properties of the different subordinate agents and elements of our globe, and of their mode of operation. We come now to consider a little more closely the general distribution of these agents and elements; and the principles upon which this distribution is regulated, so as to produce all the wonderful results which we see constantly going on around us in nature.

In the present state of the world, as we have already observed, the general tendency of its constituent principles seems to be towards a state of equilibrium or repose. But a very superficial examination of those parts of the earth's crust to which we can obtain access, is sufficient to convince us that this quietude has not *always* existed; and consequently that the present state of things must have had a beginning. In short the phenomena of geology appear to show, that our earth in its progress, has undergone, alternately, periods of comparative quietude like that in which we now live; and periods of derangement and convulsion, in which the preceding states of quietude and their consequences have been more or less subverted, and a new order of things has been induced. To enter further into details regarding these changes, however, would be quite foreign to the object of the present volume. It is the business of the Geologist to point out the changes which our earth has evidently undergone before it arrived at its present condition; to trace the earth as it were from a state of chaos through all its metamorphoses, whether sudden and convulsive, or slow and gradual; and to show that all these changes have not resulted from chance, but from the agency of an intelligent Being operating with some ulterior purpose, and according to certain laws, to which he had chosen to restrict himself—to demonstrate, in short, that to these very convulsions and changes we owe all that boundless variety of sea and of land, of mountain and plain, of hill and valley; all that endless admixture of rocks, of strata and of soils, so essential to the existence of the present order of things; without which the world would have been a mass of crystals, or one dreary monotonous void, totally unfitted for the present race of organized beings;

and particularly as a residence for man—apparently one great end and object of creation. Such is the business of the geologist; and where his duties terminate, those of the Meteorologist may be said to begin. To him it belongs more especially to consider the globe in its *present* condition of quietude or equilibrium, and the means by which this state of equilibrium is maintained: in particular, to point out the influences of heat and of light, and of the energies allied to them; to study the laws of the distribution and change of these important agents in the production of climate; to trace, in short, the effects of these wonderful principles upon the earth, the ocean, and the atmosphere, and all the infinite variety of phenomena dependent upon them.

In so wide and varied a field of inquiry it is not perhaps easy to devise a plan that shall be perfectly unexceptionable. For, as there is no one subject so entirely isolated, as not to be more or less influenced by the rest, we scarcely know which to commence with. After a good deal of reflection, we have adopted that arrangement which seems to offer the most natural view of these subjects: and at the same time appears best calculated to illustrate the design and wisdom of the Great Creator.

CHAPTER I.

OF THE GENERAL STRUCTURE OF THE EARTH: PARTICULARLY WITH REFERENCE TO THE DISTRIBUTION OF ITS SURFACE INTO LAND AND WATER; AND WITH RESPECT TO ITS ATMOSPHERE.

SECTION I.

Of the General Relations of the Sea and the Land to each other.

OUR earth may be considered as made up of materials naturally existing in the solid, the liquid, and the gaseous state, the absolute proportions of which to each other we cannot even conjecture. Of the mean density of the whole, however, we can form some estimate; and philosophers have shown that this density lies between five and five and a half, that of water being one. We can also form a tolerably precise notion of the relative proportions of the surface occupied by the solid and the liquid materials; and of the pressure and height of the atmosphere surrounding the whole.

With the general geographical distribution of land and ocean, we take it for granted that all are more or less acquainted. We shall, therefore, confine our remarks chiefly to their relative proportions;

which are such, that nearly three-fourths of the earth's surface may be said to be covered with water, while barely one-fourth, of course, must be occupied by dry land. Of this dry land, as is well known, by far the greater part is confined to the northern hemisphere; while in the southern hemisphere, the Pacific ocean exhibits a nearly continuous surface of water, greater than the whole dry land of the globe put together. According to the estimate of Humboldt, the dry land in the two hemispheres is in the ratio of three to one; between the tropics in the two hemispheres as five to four; and without the tropics as thirteen to one; the preponderance being in the northern hemisphere.

The height of the dry land above the general level of the ocean is very various; but its utmost height, as compared with the diameter of the earth, is quite trifling; and it has been shown that if the whole of the dry land existing were equally distributed over the bottom of the sea, the quantity of water in the sea is amply sufficient to cover it entirely. Hence "dry land can be only considered as so much of the rough surface of our globe as may happen for the time to be above the level of the waters; beneath which it may again disappear, as it has done at different previous periods."*

The solid portions of our earth are all made up of various combinations of the elementary principles described in a former chapter. The relative situations these principles occupy in the earth's structure; the endless proportions in which they exist; and all the infinite diversity of their properties, it is the business of the geologist and of the mineralogist to inquire into and explain: the observations, therefore, which we have to make on the present part of our subject, will be chiefly confined to the waters of the ocean, and to the atmosphere.

SECTION II.

Of the Ocean.

THE waters of the ocean are not pure, but contain, as is well-known, a variety of saline matters in solution. Indeed, when we reflect upon the immense relative extent and general circumstances of the ocean, we may naturally suppose that its waters will contain more or less of every existing soluble principle. By far the most abundant principle, however, in sea-water is common salt; which may be said to constitute, in general, nearly two-thirds of the whole saline matter present. The saline matter fluctuates between three or four per cent; and the specific gravity of the water varies, according to the proportion of the saline ingredients, from about 1026 to 1030; pure water being supposed to be 1000. The late Dr.

* De la Beche's Geological Manual, p. 2.

Marcet, some years ago, made some interesting experiments on this subject, and the following are the general conclusions which he drew from them:—

1. That the southern ocean contains more salt than the northern ocean, in the ratio of 1.02919 to 1.02757.

2. That the mean specific gravity of sea-water, near the equator, is 1.02777; or intermediate between that of the northern and that of the southern hemispheres.

3. That there is no notable difference in sea-water under different meridians.

4. That there is no satisfactory evidence that the sea at great depths is more salt than at the surface.

5. That the sea, in general, contains more salt where it is deepest and most remote from land; and that its saltness is always diminished in the vicinity of large masses of ice.

6. That small inland seas, though communicating with the ocean, are much less salt than the ocean.

7. That the Mediterranean contains rather larger proportions of salt than the ocean.*

The saltness of the sea, therefore, is considerably influenced, at least at its surface, by the neighbourhood of large rivers, and by permanent accumulations of ice; and in this way the inferior saltness of small inland seas, particularly in high latitudes, may in general be explained, as most of these inland seas are supplied with comparatively large quantities of fresh water from the rivers flowing into them. On the other hand, the superior saltness of the Mediterranean has been ascribed to the immense evaporation from its surface; the consequence principally of its being situated in a warmer climate.

The saline contents of the ocean are of immense importance in the economy of nature. Such indeed is their importance, that it is doubtful whether the present order of things could be maintained without them. The effects of these saline matters will be more particularly pointed out hereafter. In this place we shall only remark, that by lowering the freezing point of water; and by diminishing its tendency to give off vapour, they perform the most beneficial offices. Another valuable purpose which they serve may be alluded to here, viz. the greater power of buoyancy which they communicate to water; by means of which the waters of the ocean are better fitted for the purposes of navigation. Nor are these the only uses of the saline matters; for there is reason to believe that they contribute in no small degree to the stability of the water; and that an ocean of fresh water would speedily undergo changes that would probably render it incompatible with animal

* Philos. Trans. 1819.

life; such an ocean perhaps would even suffer decomposition, that might seriously interfere with the other arrangements of nature.

Lastly, who will venture to assert that the distribution of sea and of land, as they now exist, though apparently so disproportionate, is not actually necessary as the world is at present constituted? What would be the result, for instance, if the Pacific or the Atlantic oceans were to be converted into continents? Would not the climates of the existing continents, as formerly observed, be completely changed by such an addition to the land, and the whole of their fertile regions be reduced to arid deserts? Now, this distribution of sea and of land, so wonderfully adapted as it appears to be to the present state of things, depends of course in a great measure upon the *absolute quantity* of water in the world. While on the other hand, the *relative gravity* of water, as compared with that of the earth, keeps the ocean within its destined limits, notwithstanding its incessant motion. Thus Laplace has shown that the world would have been constantly liable to have been deluged from the slightest causes, had the mean density of the ocean *exceeded* that of the earth! Hence the adjustment of the quantity of water and of its density, as compared with that of the earth, afford some of the most marked and beautiful instances of design.

SECTION III.

Of the Atmosphere.

THAT immense body of gaseous matters surrounding our earth, and usually known under the name of the Atmosphere, is essentially composed, as we formerly stated, of two principles, oxygen and azote, in the proportion nearly of one part of oxygen and four parts of azote. Besides these two gases, the atmosphere also contains a small and perhaps a variable quantity of carbonic acid gas, amounting upon an average to about one part in a thousand of the whole; and of water in a state of vapour, likewise a variable quantity, (as will be shown hereafter,) but usually fluctuating between one, and one and a half per cent. In addition to these, there are, probably also other matters constantly present in the atmosphere; for as the sea contains a little of everything that is soluble in water, so the atmosphere may be conceived to contain a little of everything that is capable of assuming the gaseous form.

The atmosphere exerts a pressure or weight upon all parts of the earth's surface, on an average equal to about fifteen pounds upon a square inch; or in other words, equal in weight to a column of mercury one inch square and thirty inches high. The well-known instrument the common *Barometer* or *Weather-glass*, consists of nothing more than such a column of mercury, poised or pressed upwards into a vacuum, by the weight of the atmosphere. With the

changes constantly taking place in the height of such a column, every body is familiar, and we shall have occasion to recur to them hereafter; at present it is only requisite to observe, that these changes are much less remarkable in tropical than in temperate climates. Thus, between the tropics the barometer usually varies only about one-third of an inch; while in temperate climates, the changes amount to upwards of one-tenth of the whole height.

The pressure of the atmosphere decreases as we ascend above the earth's surface; and for equal ascents, this decrease of density is in what is called geometrical progression. Thus, at three miles in height, the density of the atmosphere is only one-half of what it is at the surface of the earth, or equal to a column of mercury fifteen inches in height; at six miles, the barometer would stand at one-fourth of its usual height, or seven and a half inches; at nine miles of elevation, at three inches and three quarters; and, at fifteen miles, nearly at one inch only. Hence by far the greater portion of the atmosphere is always within fifteen or twenty miles of the earth's surface; though from various circumstances it has been inferred to extend from forty to forty-five miles in height. This height however, must be different in different latitudes; for the rotation of the earth upon its axis, and the greater and more direct influence of the solar heat upon the earth's equatorial regions, will necessarily cause the atmosphere to be higher there than in the polar regions; at the poles, the atmosphere must be lower than over any other part of the earth's surface. These are most important circumstances in the economy of nature, as we shall see hereafter.

Much difference of opinion has existed among philosophers as to the mode in which the various principles entering into the composition of atmospheric air are associated; some maintaining that these principles exist simply in a state of mixture: others considering them as chemically united. We formerly stated that all gaseous bodies, when they combine with one another, combine with reference to their volumes; that is to say, that one volume of one gas always combines with one, two, or more similar volumes of the same, or of another gas, and not with any intermediate fractional part. Now, as atmospheric air is composed essentially of one volume of oxygen and four volumes of azote, it is evident, whether its elements be in actual union or not, *that it is at least constituted upon strictly chemical principles*; whence it follows, that the composition of the atmosphere has not been the result of accident. In this point of view, therefore, atmospheric air may be considered to be as much a chemical compound as water, or any other similar body; and instead of viewing the atmosphere, according to a prevalent notion, as a mere accidental and heterogeneous appendage connected with the denser matters by no apparent tie, we may fairly rank the atmosphere among the constituent principles of our globe, and as forming a symmetrical part of the great harmonious whole.

But although atmospheric air has been thus originally constituted upon chemical principles, and probably owes to this circumstance, in no small degree, its stability; yet the mode in which its constituent elements are associated, is very different from that in which the elements of compounds in general are associated. Indeed the constituent elements of atmospheric air do not appear to be combined at all; but to be only mixed, or simply diffused through each other, in the same manner that the minute portions of carbonic acid gas and of vapour are known to be diffused through the whole atmosphere; that is to say, according to the laws of the general diffusion of gaseous bodies which we endeavoured to explain in a former chapter. To this explanation we must refer the reader for details. We shall merely observe here, that the fundamental principle of this explanation consists in the assumption, that the molecules of all bodies in the gaseous state are self-repulsive (or repulsive of one another, in preference to others,) for the same reason that in the solid state they are self-attractive (or attract one another, in preference to others). When different gaseous bodies therefore, are mixed together, they will not assume a position according to their specific gravities, as they might otherwise be expected to do; but the molecules of each gas will be equally diffused throughout the whole space occupied by the mixture. Hence, one direct and most important effect of the mixed constitution of the atmosphere, is *its nearly uniform composition*, at least within the limits attainable by man—a fact that has been confirmed by innumerable analyses of the air, made in all parts of the world, both at its surface and at the greatest heights hitherto reached. Moreover, this constitution of the atmosphere not originally produced such uniformity of composition, but it *is the cause constantly operating to preserve that uniformity*—the grand conservative principle, as it were, preventing any unequal distribution of the constituent elements of the atmosphere, which would speedily prove fatal to organic life! Were the gaseous principles composing the atmosphere in ever so slight a state of union, they could not readily diffuse themselves through each other; and partial accumulations of one or other of them would be constantly taking place; but as the atmosphere is at present constituted, if a little more oxygen be consumed in one spot than another, instantly the deficiency is supplied from the neighbourhood by diffusion, and the equilibrium is scarcely affected in a sensible degree. Another curious result of this independent condition of the gaseous principles of the atmosphere is, that of the whole pressure exerted, each principle exerts its own force according to its quantity. Thus, of the thirty inches of mercury supported by the whole atmospheric pressure, the azote sustains $23\frac{3}{100}$ inches, and the oxygen $6\frac{1}{100}$ inches; while the aqueous vapour sustains only $\frac{4}{100}$ inch, and the carbonic acid still less, or only $\frac{2}{100}$ inch. Hence it is evident that the fluctuations in the height of the barometer, amounting to nearly three inches

in our latitude, cannot depend altogether upon the quantity of aqueous vapour in the atmosphere; for if the whole of this vapour were annihilated, it would scarcely produce a difference in height of half an inch. Attention is now drawn to this fact for purposes that will appear in a subsequent chapter.

Lastly, had the absolute quantity, or the relative gravity, of the atmosphere been materially different from what they are, the present order of things could not have existed. Hence, the same striking evidences of wise adjustments are displayed in these arrangements of the atmosphere, as in those formerly shown to exist with respect to the quantity and gravity of the ocean.

Before we close the present chapter, let us reflect for a moment upon the great arrangements we have been considering.

Why has the surface of this earth been divided into land and sea? Why have the land and sea been so adjusted to each other, that their condition and properties hardly admit of change without destruction to the whole fabric? Why has their present stability been so wonderfully secured! Again, with respect to the atmosphere; why has there been any atmosphere thrown around this globe? and why such manifest provisions to secure its ubiquity and unvarying constitution?

Viewed alone and without reference to organized beings, all these things appear without an object. This globe might have revolved about the central luminary—might have occupied its point in the universe without any “gathering together of the waters,” without any circumambient air. But the scheme of the great Creator extended beyond the mere adaptation of inanimate matter. “Before its foundations were laid,” He had destined this earth to teem with life, and throughout has displayed his original design of rendering it a fit habitation for living beings. For this purpose and acting at the same time, in strict conformity to those laws, by which He had chosen to limit himself, He has, by means of successive convulsions and changes, so contrived to mix and blend the different elements, and finally so to arrange the dry land apart from the sea; that, taken as a whole, and with reference to the present order of things, their relative proportions will scarcely admit of material change. While to crown his works, and as it were, the more strongly to evince his design, and his wisdom, He has surrounded the whole with an atmosphere, to preserve the homogeneity of which, its principles have been so associated, as to constitute an exception to his usual operations, and even to the general laws of nature!

CHAPTER II.

OF HEAT AND LIGHT—THE MODES OF ESTIMATING THEIR DEGREE, AND THE WAYS IN WHICH THEY ARE PROPAGATED.—OF THE GENERAL TEMPERATURE OF THE CELESTIAL REGIONS, AND OF THE EARTH INDEPENDENTLY OF THE SUN.

SECTION I.

Of Heat and Light, and the Modes of estimating their Degree.

OUR sensations are a very imperfect and uncertain measure of temperature, and when we wish to speak with precision on that subject, it becomes necessary to have recourse to other means of comparison. For the sake of the general reader, we shall, therefore, in the first place, briefly describe the principles of the construction of the *Thermometer*, the instrument for measuring heat.

All bodies, as we have shown in a former chapter, become more or less expanded when they undergo an increase of temperature. Hence the relative degrees of expansion of a body may be employed as a sort of measure of the degree of heat; and most of the thermometers employed, act upon this principle. Thus the common thermometer, as is well known, consists of a portion of some fluid, generally of mercury, enclosed in a small glass ball furnished with a hollow stem, the narrow bore of which communicates with the general cavity of the ball. We shall suppose the quantity of the mercury, and the size of the ball, to be so adjusted to each other, that when the instrument is placed in ice on the one hand, and in boiling water on the other, the whole expansion of the mercury between these two fixed points, shall fall within the range of the stem or tube. The points at which the mercury stands in the tube, at the freezing and boiling temperatures are to be accurately noted; and the intermediate space upon the scale attached to the tube, is to be divided into 180 equal parts or degrees; the freezing point is to be marked 32° , and of course, the boiling point 180° above, or 212° . Such is *Fahrenheit's* scale, the one employed in this country, and to which the numbers hereafter mentioned refer. In other countries different scales are made use of; and in France particularly, what is termed the *centigrade* thermometer is generally adopted. In this thermometer the freezing point is marked 0° and the boiling point 100. In other parts of the continent *Reaumur's* scale is much used. In Reaumur's the freezing point, as in the Centigrade, is 0° , but the boiling point is only 80° . These different graduations are easily convertible, but it is much to be regretted that they exist, as they cause considerable trouble and confusion.

The instrument employed for measuring the intensity of light is termed a *Photometer*; of such an instrument various forms have been proposed, but at present they are all very imperfect.

SECTION II.

Of the Propagation of Heat and Light.

THE modes in which heat and light are propagated from one body to another, and through the same body, have been already explained, and we need not again enter into details: a brief recital here, however, of the modes in which heat and light are propagated, may not be unacceptable to the general reader.

Heat passes from the sun to the earth by *radiation*; and again, by the same process, it is freely sent off from the surface of the earth into the atmosphere. Below the surface of the earth, heat is propagated in all directions through the *solid* matter, by what is called *conduction*. A third mode in which this important agent is extensively propagated in nature, is by the means we have termed *convection*, or the *carrying* process. Convection is confined, of course, to fluids, as water and air. A portion of water or of air being heated above, or cooled below the surrounding portions, expands or contracts in magnitude, and thus becoming specifically lighter or heavier, rises or sinks accordingly; carrying with it, the newly acquired temperature, whatever that temperature may be.

Light, at present, is only known to be propagated by radiation.

By bearing in mind these modes of the propagation of heat and light, the general reader will find no difficulty in understanding what follows.

SECTION III.

Of the Temperature of the Celestial Regions.

FROM the close and intimate relations between heat and light, and from their almost invariable association as they exist around us, it seems not very unreasonable to conclude that these agencies are generally associated in nature; and that wherever one is present, there the other must be present also. If this be really the case, the innumerable fixed stars, considered to be so many suns, must be supposed capable of diffusing heat as well as light throughout the celestial regions; and consequently there must be a certain degree of temperature common to the whole. For this reason, and for others that might be mentioned, philosophers have not only inferred the existence of such a common temperature existing throughout the celestial regions, independently of our sun; but have even

attempted to determine its degree. Moreover, it is singular that all the different modes which have been employed to estimate this temperature, concur in showing that it does not differ much from—58° of Fahrenheit's scale; that is to say, about 90° below the freezing point of water; a degree of cold "not greatly inferior to that at which quicksilver becomes solid, and much superior to some degrees of cold which have been produced artificially."* If such a common temperature really exists throughout space, or at least in our planetary system, it must have no inconsiderable influence upon the temperature of the planets generally; and with respect to our own globe in particular, such a common temperature must operate by diminishing the intensity of the cold around the poles.

SECTION IV.

Of the Temperature of the Interior of the Earth.

THE attention of philosophers has, for some years past, been a good deal directed to the internal temperature of the earth, at great depths, beyond the influence of the sun or of any other external cause. From the earliest times some vague notions of a central heat seem to have existed among mankind; doubtless, arising from their attention being forcibly drawn to the phenomena of volcanoes and hot springs; but it is not till a comparatively late period that the subject has been carefully investigated. It would be quite foreign to our design to enter here into details upon this point; we shall therefore merely state, that the arguments in favour of the probability of a central heat are—"first, the experiments made in mines, which, notwithstanding their liability to error from various sources, still seem to show, particularly those made in the rock itself, an increase of temperature from the surface downwards;—secondly, the existence of thermal springs, which are not only abundant among active and extinct volcanoes, but also among all varieties of rocks in various parts of the world;—thirdly, the existence of volcanoes themselves, which are distributed over the globe, and present such a general resemblance to each other that they may be considered as produced by a common cause, and that cause, probably, deep-seated;—and lastly, the terrestrial temperature at comparatively small depths, which does not coincide with the mean temperature of the air above it."†

Such is an abstract of the principal arguments which have been brought forward in support of the opinion, that within our earth, even at the present time, there exists a central heat of great inten-

* Discourse on the Study of Natural Philosophy; p. 157. By Sir J. F. W. Herschell.

† De la Beche's Geological Manual, p. 24, new ed.

sity. As corroborative of the same views, may be mentioned the evidence derived from the characters of the fossil remains both of plants and of animals, found in the colder regions of the world; which characters are such as to prove beyond a doubt, that these plants and animals must have existed in a climate much hotter than that in which their remains are found, and indeed, of equal, if not of superior, heat to that of the tropical portions of our earth at this time. Hence it has been inferred, that the temperature of our earth, formerly much above what it is now, has been gradually dissipated into the surrounding planetary regions, and thus helped to increase the general temperature, above stated, as supposed to exist throughout space. Moreover, the same distinguished philosopher,* to whom we are principally indebted for these observations, has attempted to show that the earth has nearly reached its limit of cooling, particularly near the surface. Near the surface the temperature would necessarily decrease much more rapidly than in the interior; where, in a globe of the earth's magnitude, the temperature might be supposed to remain nearly unchanged for a very great length of time. He has also attempted to show that the temperature of the surface is still liable to be influenced, by the gradual escape of heat from the interior which even yet seems to be constantly going on; and that the temperature of the surface is thus somewhat higher than it would be if such a central heat did not exist; or than if the temperature of the surface of the earth depended only upon the action of the sun. And this brings us to the point at which our subject may be said properly to begin, viz. the consideration of the *present state* of the earth's temperature, as liable to be influenced by the presence or absence of the sun, the great source of heat and of life to our system.

Before proceeding, we may remark, that the details of the subject we have now concluded, fall entirely within the province of the geologist. To him it belongs, as we have already said, not only to trace the wonderful changes which our globe has undergone in arriving at its present condition, but to point out the beautiful adaptations of organic life and structure to the existing circumstances of its various epochs. Considered in this point of view, geology is a subject of the highest interest and importance; and, to use the words of an eminent Professor, with which we shall finish this chapter, "lends a great and unexpected aid to the doctrine of final causes; for it has not merely added to the cumulative argument, by the supply of new and striking instances of mechanical structure adjusted to a purpose, and that purpose accomplished; but it has also proved that the same pervading active principle manifesting its power in our times, has also manifested its power in times long anterior to the records of our existence.

* Baron Fourier.

“But, after all,” continues our author, “some men, seeing nothing but uniformity and continuity in the works of nature, have still contended (with, what I think, a mistaken zeal for the honour of sacred truth) that the argument from final causes proves nothing more than a quiescent intelligence. I feel not the force of this objection. In geology, however, we can meet it by another direct argument; for we not only find in our formations organs mechanically constructed, but at different epochs in the history of the earth we have great changes of external conditions, and corresponding changes of organic structure; and all this without the shadow of a proof that one system of things graduates into, or is the necessary and efficient cause, of the other. Yet in all these instances of change, the organs, as far as we can comprehend their use, are exactly those which were best suited to the functions of the being. Hence, we not only show intelligence contriving means adapted to an end, but at successive times and periods contriving a change of mechanism adapted to a change in external conditions. If this be not the operation of a prospective and active intelligence, where are we to look for it?”*

CHAPTER III.

OF THE TEMPERATURE OF THE EARTH AT ITS SURFACE, AS DEPENDENT ON THE SUN.

THE general temperature of the earth is doubtless regulated by its situation in the universe, and more especially by its position with respect to the sun. To this position, as formerly observed, the properties of its constituent principles have, most obviously, been all adapted with consummate wisdom; so that, under the circumstances in which they are placed, some are solid, some liquid, others gaseous, according to the purposes they are intended to fulfil in nature.

But the heat and light derived from the sun are very unequally distributed over the surface of the earth; and every one is familiar with the fact, that as we recede from the equator towards the north or south, the temperature of the earth's surface gradually diminishes till we arrive at the polar regions.

Such is the general fact. But the circumstances which conspire to interfere with this gradual distribution of temperature are so numerous and so influential, that the actual temperature of a place can be learnt only by observation. Among the circumstances thus more

* Address delivered to the Geological Society of London, by the late President, Professor Sedgwick, 1831.

especially affecting the distribution of temperature, may be mentioned the nature of the surface, whether water or land,—and the situation, whether at a greater or at a less height above the level of the ocean. To these may be added the particular configuration and geographical relations of places: such as their aspect to the north or south; their being sheltered or exposed; the composition and nature of the soil, such as its colour and state of aggregation, on which depend its powers of absorbing and of radiating heat and light, and of retaining or of parting with humidity, &c.; also the proximity or absence of seas; the predominancy of certain winds; the frequency of clouds, fogs, &c. These, and innumerable other circumstances, many of which will be pointed out in subsequent chapters, contribute to influence the temperatures of particular places, and to render them, in fact, as varied as the places themselves.

Nor is difference of place the only cause of vicissitude of temperature; every one knows that at the *same* place the temperature is in a constant state of change. Hence before we can obtain correct notions of the actual temperature of any given place or period, certain expedients are necessary which we have in the first place to consider.

SECTION I.

Of Mean Temperature.

IF, on any given day, we observe the temperature at the earth's surface, at the commencement of every one of the twenty-four hours, we shall find, as before observed, that at each hour the temperature is different; and we naturally inquire which of all these temperatures is to be chosen in preference, as the one characteristic of the day and place? The answer to this question obviously is; *that temperature, whatever it may be, which is equidistant from the extremes*, or, as it is usually termed, the *mean temperature of the whole*. Now this mean temperature may be obtained, nearly by adding all the results together, and dividing the sum by the number of observations; thus we arrive at the mean temperature of the day, by adding together the temperatures observed at different hours of the day, and dividing the sum by the number of temperatures. In the like manner by adding together the mean temperatures of every day of a week, or of a month, and dividing the sum by the number of days, we obtain the mean temperature of the week or month; and so on, by similarly treating the mean temperature of the months, or of any number of years, we obtain the *mean* temperature of the year, at a given place: and it is to be observed that the greater the number of observations the more accurate will be the mean result.

Lastly, it remains to state that the temperature always understood by the Meteorologist (except otherwise expressed) is that of the air near the surface of the earth, as indicated by a thermometer effectually protected from radiation and foreign influence of every kind. The temperature as indicated by a thermometer fully exposed to solar radiation, and which in its turn is allowed to radiate freely in the sun's absence, is altogether a different thing; and may be imagined to coincide very nearly with the actual temperature of the earth's surface, when similarly exposed. The fluctuations of temperature indicated under these circumstances are much greater than those of the air above noticed, though it is probable that the mean of the whole of such observations, if this mean could be accurately obtained, would differ little from the mean of those of the air.

SECTION II.

Of the actual Distribution of Temperature over the Globe. Of Isothermal Lines, &c. CLIMATE.

THE reader is supposed to be acquainted with the principles of the common division of the surface of the globe into five zones or portions, usually denominated the *torrid*, the two *frigid*, and the two intermediate *temperate zones*; and that generally speaking the poles and the equator present the extremes of temperature upon the earth's surface. Now, in considering the general distribution of temperature over the globe, the extreme temperatures naturally claim our attention in an especial manner: we shall, therefore, in the first place, proceed to consider the temperature of the polar and of the equatorial regions.

Of the Temperature of the Poles and of the polar Regions.—The probable mean temperature of the poles has always been an interesting subject of meteorological inquiry. It must be confessed, however, that after all that of late years has been done by our enterprising countrymen, much is yet necessary to enable us to arrive at satisfactory conclusions. Thus it has been shown that in attempting to calculate the temperature of the North Pole, we shall obtain very different results by employing the temperature occurring in the old world, and that observed in the new world; the temperature of the old world indicating the temperature of the pole to be about 10° ; while the temperature of the new world indicates it to be considerably below Zero. Hence it has been inferred, that there are two points or poles of greatest cold situated in about the latitude of 80° north, and in longitudes 95° east, and 100° west; and consequently that the geographical pole of the globe is not the coldest point of the Arctic hemisphere. Whether this deduction be well founded or not must be decided by future observation. At present the actual

temperature of the polar regions cannot be considered as determined.

Although we are thus unable to state with certainty the temperature of the Polar regions, it may nevertheless be deemed an object of curiosity to know the *lowest* temperatures that have been noticed. Perhaps the lowest *authentic* observations of temperature we possess are those by Captain Parry at Melville Island. Here the thermometer in the ship was often observed as low as -50° ; and at a distance from the ship even as low as 55° under Zero. We believe still lower temperatures than these are on record, but probably they are not to be relied on. The greatest degree of cold hitherto produced *artificially* has been 91° under Zero.

Of the mean annual Temperature of the Equator. The mean annual temperature of the equatorial, like that of the polar regions, is a meteorological problem of considerable interest. Humboldt, from a very extensive generalization, fixed the mean equatorial temperature at $81\frac{1}{2}^{\circ}$; and the same temperature has been adopted by others. Attempts, however, have been recently made to show that this temperature is 3° or 4° below the truth; but Humboldt, in reply still maintains his former opinion. Since at the equator, only about one-sixth of the whole circumference of the globe is dry land, the general equatorial temperature, as actually found to exist, is perhaps lower than upon theoretical principles it ought to be; and certainly much below what it ought to be, as deduced from observations made on the continent in the neighbourhood of the equator. Thus the mean temperature of Pondicherry, in latitude $11^{\circ} 55'$ north is at least 85° ; and if from this temperature that of the equator were deduced according to the common principles, the deduction would of course be much above the truth. The fact is, as in the case of the polar regions, we do not possess the requisite data for determining the equatorial temperature in a perfectly satisfactory manner.

As in speaking of the polar regions, we noticed the *lowest* degree of temperature which had been observed, perhaps while speaking of the equatorial regions it may not be deemed irrelevant to notice the *highest* temperature. Observations, however, of this kind, being principally founded on the incidental notices of travellers, are not, in general, much to be relied on; or are to be considered only as approximations. Thus the thermometer has been recorded at Benares to stand at 110° , 113° , and even 118° . At Sierra Leone, it has been observed, when placed on the ground to indicate a temperature of 138° . Humboldt also gives many instances of the temperature of the surface of the earth, amounting to 118° , 120° , and 129° ; and on one occasion he found the temperature of a loose and coarse granitic sand to amount to upwards of 140° , the thermometer in the sun at the time only indicating a temperature of about 97° .

Of the Temperature of the intermediate Regions of the Globe. Of Isothermal Lines, &c. With respect to the temperatures of those parts of the earth between the poles and the equator, it may be remarked, that, except for reference only, the old division, before mentioned, of the earth's surface into zones is now almost entirely superseded by the more precise and natural arrangement, termed the *Isothermal* arrangement. According to this arrangement, all the places upon the globe having *the same annual mean temperature* are classed together; and lines drawn upon a map through such a series of places, have been termed *Isothermal lines, or lines of equal temperature*. As might be expected from what has been already stated, the courses of these lines are by no means regular. Thus, suppose two travellers set out, the one from London and the other from Paris, and each visit all the places in the northern hemisphere in which the mean annual temperatures are the same as in these two cities. It will be found that the lines of their routes, or the isothermal lines of these two cities, will not only not follow the parallels of their latitude, but that they will not be parallel to each other; and the same may be said to be the case with any other two places upon the globe. Hence, as the isothermal lines are as numerous as the places, and as diversified as numerous, geographers have grouped them into bands or zones. Thus Humboldt (to whom we owe most that has been done on this subject) has divided the northern hemisphere into the following six isothermal bands or zones, viz.:

1.	The zone of mean annual temperature ranging	from 32° to 41°.
2.	- - - - -	from 41° to 50°.
3.	- - - - -	from 50° to 59°.
4.	- - - - -	from 59° to 68°.
5.	- - - - -	from 68° to 77°.
6.	- - - - -	from 77° upwards.

The tables given in the appendix contain a general view of Humboldt's results. We shall content ourselves with briefly pointing out the approximate course of the most interesting of these lines, viz. *the Isothermal line of 32°*.

If we begin to trace this important line from the eastern parts of Siberia in longitude 130° east, we shall find that in this meridian it commences nearly in the latitude of 59° north; whence it makes a gradual bend northwards, and crosses the parallel of 60°, nearly in longitude 90°. From this point it still advances to the northward, and crossing the arctic circle in longitude 45° east, arrives at its most northern extremity in about latitude 67½°, longitude 10° east. From this its most northerly limit our line takes a gradual sweep towards the south, recrosses the arctic circle in longitude 15° west, and passing through the north-west of Iceland, divides the parallel of 60° in longitude 42° west. From this spot it proceeds southwards to the latitude of 54°, a little to the north of Table Bay, in Labrador;

gradually declining in its course till it arrives at longitude 100° west, in the central parts of the new continent. Hence the Isothermal line of 32° , ranges through a space of 14° or 15° of latitude; while its western extremity, in the central parts of America, is 5° or 6° nearer the equator than its eastern extremity in Siberia—a circumstance strikingly illustrative of the greater cold of the new continent in the same parallel of latitude. The most remarkable circumstance connected with them is, that as they approach the equator they gradually become less convex towards the north, so that the Isothermal line of 77° differs but little from a straight line, coincident with the tropic of cancer.

In the arrangement above described the mean temperatures of the *whole year* are supposed to be classed together; but it is obvious that the same principle may be applied to any portion of the year, as the extreme winter and summer temperatures. Such classifications are often, as we shall presently see, of great importance in enabling us to estimate the characters of a particular country. Thus, lines drawn through places having the same summer and the same winter temperatures, are denominated *Isothermal* and *Isocheimal* lines; while lines drawn through places having other common temperatures, receive other appropriate names.

After these general remarks, we proceed to give a summary sketch of the actual distribution of temperature over the *northern hemisphere*, which we shall subjoin in the words of Humboldt.

“The whole of Europe,” says this distinguished philosopher, “compared with the eastern parts of America and Asia has an insular climate; and upon the same Isothermal line the summers become warmer and the winters colder, as we advance from the meridian of Mont Blanc towards the east or the west. Europe may be considered as the western prolongation of the old continent; and the western parts of all continents are not only warmer at equal latitudes than the eastern parts; but even in the zones of equal annual temperature, the winters are more rigorous, and the summers hotter on the eastern coasts than on the western coasts of the two continents. The northern part of China, like the Atlantic region of the United States, exhibits seasons strongly contrasted; while the coasts of New California and the embouchure of the Columbia have winters and summers almost equally temperate. The meteorological constitution of those countries in the north-west resembles that of Europe as far as 50° or 52° of latitude. In comparing the two systems of climates, the concave and the convex summits of the same Isothermal lines, we find at New York the summer of Rome and the winter of Copenhagen; at Quebec, the summer of Paris and the winter of St. Petersburg. At Peking, also, where the mean temperature of the year is that of the coasts of Brittany, the scorching heats of summer are greater than at Cairo, and the winters are as rigorous as at Upsal. So also the

same summer temperature prevails at Moscow, in the centre of Russia, as towards the mouths of the Loire, notwithstanding a difference of 11° of latitude; a fact that strikingly illustrates the effects of the earth's radiation on a vast continent deprived of mountains. This analogy between the eastern coasts of Asia and America sufficiently proves," continues Humboldt, "that the inequalities of the seasons depend on the prolongation and enlargement of continents towards the pole; on the size of seas in relation to their coasts; and on the frequency of the north-west winds, and not on the proximity of some plateau or elevation of the adjacent lands. The great table lands of Asia do not stretch beyond 52° of latitude; and in the interior of the new continent, all the immense basin bounded by the Alleghany range, and the rocky mountains, is not more than from 656 to 920 feet above the level of the ocean."

The following remarks apply to *the temperature of the southern hemisphere*.

The general temperatures of the northern and of the southern hemispheres are understood to differ very considerably. This difference, however, does not depend upon any material difference in the proportion of heat and light derived from the sun, as will be presently shown; but on the very unequal distribution of sea and of land in the two hemispheres. The small quantity of land in the southern hemisphere contributes not only to equalize the seasons, but also to diminish the annual temperature of that part of the globe; and hence the polar ice in the southern hemisphere advances more towards the equator than in the northern hemisphere, particularly where the Antarctic Ocean is free from land.

Humboldt has shown, that near the equator, and indeed so far south as 40° or 50° , the correspondent Isothermal lines are in both hemispheres almost equally distant from the poles; and that, in considering only the transatlantic climate between 70° and 80° of west longitude, the mean temperatures of the year, under corresponding geographic parallels, are even greater in the southern than in the northern hemisphere. It is the *division* of heat, therefore, between the different seasons of the year, rather than the absolute amount of heat, during the whole year, that gives a particular character to southern climates, and approximates them generally to the character of insular climates. Thus, in the southern hemisphere, and on the Isothermal lines 46.4° and 50° we find summers which, in our hemisphere, belong only to the Isothermal lines of 35.6° and 40° . The mean temperature is not precisely known beyond 51° of south latitude; yet there is no reason to infer that the Isothermal line of 32° is much further from the south pole, than in the opposite hemisphere, the similar line is from the north pole; and some circumstances at first sight appear to show that the Isothermal line of 32° is even nearer to the south pole than it is to the north pole; though these circumstances are probably deceptive. With respect to the tempera-

ture of the south pole itself, like that of the north pole, we have no means of forming an accurate estimate.

Such is a summary account of the general distribution of temperature over the northern and southern hemispheres. Now amidst the infinite changes everywhere going on, there is nevertheless at the same place a certain average state of things which taken together, constitute what is called the CLIMATE of the place. Of climate, undoubtedly, temperature is the most important ingredient. But the circumstances, besides mere temperature, which enter into the formation of climate, are so numerous and diversified, and their operation, in consequence, is so complicated, that it becomes exceedingly difficult to unravel and display them in a satisfactory manner. The constituents of climate, however, appear to be most naturally divided into two great sections; viz., *those of a PRIMARY kind depending upon the globular figure of the earth; upon its motion in its orbit, and upon its axis: and those of a SECONDARY, or a subsidiary kind, more immediately connected with the globe itself, and depending upon the nature of its surface, as composed of land or water; or, as connected with its atmosphere.* Under these two points of view, we purpose to consider the subject of CLIMATE, in the following chapters.

CHAPTER IV.

OF THE PRIMARY CONSTITUENTS OF CLIMATE: OR, OF THE TEMPERATURE OF THE EARTH, AS DEPENDENT ON ITS GLOBULAR FORM; AND ON ITS ANNUAL AND DIURNAL MOTIONS.

THE distance of the earth from the sun is such, that the solar rays may be supposed to arrive at the earth's surface in a state of parallelism. Now, when parallel rays fall upon a globe, it is obvious that any number of such rays falling perpendicularly, as at the equator of our earth, will occupy a very different portion of the surface of the globe, from what an equal number of the same rays will occupy where they fall obliquely, as in our polar regions. Hence, as we recede from the equator towards each pole, heat and light are diffused over gradually increasing portions of the earth's surface, and thus the intensity of both decreases in a like proportion. The exact law of such decrease is well known to mathematicians, but need not be here repeated. For our present purpose it is sufficient to observe, that among the natural causes affecting the distribution of heat and light in different latitudes, the globular figure of the earth is the principal.

The second great natural cause of the unequal distribution of heat and light over the earth, is the obliquity of the earth's motion in its orbit with respect to the plane of its equator. From this obliquity it happens that, during the annual revolution of the earth round the sun, every part of its surface, between the latitudes of $23\frac{1}{2}^{\circ}$ north and south from the equator, is in turn exposed to the perpendicular influence of the sun. To this oblique motion of the earth in its orbit we owe the endless variations and vicissitudes of seasons in different latitudes.

There is also another circumstance connected with the earth's motion in its orbit, which, as partaking of the character of a primary cause, may here be briefly noticed. The earth's orbit is not a circle, but an ellipse, of which the sun occupies one of the *foci*. Now, it has been so arranged, that in the middle of our winter, the earth is in that part of its orbit which is nearest to the sun. The earth, therefore, is at Christmas actually about three millions of miles nearer to the sun than at Midsummer. Hence it might be inferred that the temperature of the southern hemisphere, which during our winter is directly exposed to the sun, would be effected by this greater proximity. Such, however, is not the case; for this greater proximity to the sun is almost exactly counterbalanced by the swifter motion of the earth along this part of its orbit. The eccentricity of the earth's orbit, therefore, has little or no influence on its temperature as at first sight might be supposed.*

The third great natural cause affecting the distribution of heat and light over the earth is the earth's revolution on its axis. To this revolving motion we owe the innumerable minor vicissitudes of temperature, and of light and shade, daily and hourly experienced throughout the world.

Such are the three great natural causes which regulate the distribution of heat and light over our globe. They may be considered as the necessary results of more general laws to which the Great Author of nature has chosen to restrict himself, and to which, as usual, He most rigidly adheres. Why, among the numerous possible means by which heat and light might have been, and in other instances, are distributed from a central sun over a distant

* Or, perhaps, to quote the more precise explanation of Sir J. Herschel, "The momentary supply of heat received by the earth from the sun varies in the exact proportion of the angular velocity, that is of the momentary increase of longitude. Hence the greater proximity of the sun in the winter is exactly compensated for by the earth's more rapid motion, and thus an equilibrium of heat is, as it were, maintained. Were it not for this, the eccentricity of the orbit would materially influence the transition of the seasons; and the effect would be to exaggerate the difference of summer and winter in the southern hemisphere, and to moderate it in the northern; thus producing a more violent alternation of climate in the one hemisphere, and an approach to perpetual spring in the other. As it is, however, one such inequality subsists, but an equal and impartial distribution of heat and light is accorded to both." Treatise on Astronomy, p. 198, (Lardner's Cyclopædia).

planet, these regulating causes have been selected for our earth, is absolutely unknown to us. That this selection has been made with some ulterior view we cannot hesitate to believe; and one such view or purpose may have been to demonstrate to us His wisdom and His power, by the methods chosen for obviating the difficulties necessarily resulting from these primary arrangements. In other planets, where other primary arrangements for the distribution of heat and light have been adopted, there are probably other modes of obviating the difficulties arising from them. Of such arrangements we can form no conception; but to the inhabitants of these planets, they are doubtless an equal evidence of the wisdom and the power of the Deity.

CHAPTER V.

OF THE SECONDARY OR SUBSIDIARY CONSTITUENTS OF CLIMATE : COMPREHENDING A SKETCH OF THOSE CIRCUMSTANCES CAPABLE OF INFLUENCING CLIMATE WHICH ARE MORE IMMEDIATELY CONNECTED WITH THE SURFACE OF THE GLOBE, AS CONSISTING OF LAND OR WATER ; OR WHICH ARE CONNECTED WITH THE ATMOSPHERE.

In the preceding chapter we have alluded to the difficulties or exigencies necessarily arising from the modes in which heat and light are distributed over our globe; and of these, before we proceed, it may be proper to specify some of the most striking.

Had the heat and light derived from the sun to the earth not been in any way modified, the equatorial and the polar regions would have been alike inaccessible to organic life. The heat within the tropics and the cold towards the poles, would both have been destructive; while the intermediate regions would have been exposed to a constant succession of violent and sudden alternations of temperature, that would have rendered the present state of things no less an impossibility. In order, therefore, to render this earth an appropriate dwelling-place for such beings as at present occupy its surface, it was necessary that these extremes and sudden vicissitudes of temperature should be in some way diminished and alleviated. Accordingly these objects have been effected with the most consummate wisdom. Indeed, some of the most splendid instances of design in nature are offered by those subsidiary arrangements, by which the difficulties necessarily arising from the primary arrangements are obviated or mitigated; and by which the greater portion of the earth's surface has been made accessible to organic beings of

the same general character. These subsidiary arrangements it will be our business to explain in the present chapter.

The secondary or subsidiary constituents of climate naturally divide themselves into two great sections; viz., *those connected with the surface of the globe, as composed of land or water; and those connected with the atmosphere.*

In the following sketch of these constituents of climate we have endeavoured as usual to elucidate principles rather than to enter into details; and, as far as is compatible with a general and popular view, have attempted to point out the modes in which the laws of light and heat, described in the first Book, operate, so as to produce the phenomena of climate.

SECTION I.

Of the secondary Constituents of Climate, immediately connected with the Surface of the Globe; and depending on the Nature of that Surface as composed of Land or Water.

IN attempting to illustrate the operation of the laws of heat and light in the formation of climate, we shall follow the order nearly in which these laws were discussed in the previous chapters; that is to say, we shall first consider the influence of heat and light as depending on their latent and decomposed forms; and afterwards their influence as depending on their radiation, conduction, and convection.

In the prosecution of this difficult inquiry, the first circumstance which naturally claims our attention, is the absolute quantity of heat and light derived from the sun to the earth.

1. *Of the Proportion of Solar Heat and Light that actually arrives at the Surface of the Earth.* Of the absolute quantity of heat and light derived from the sun to our globe we have no means of forming an exact estimate. M. Pouillet has attempted to show that the amount of heat annually received by the earth from the sun, is equal to that which would be required to melt a stratum of ice nearly forty-six feet thick, and covering its whole surface.* This estimate, however, is to be viewed only as a rude approximation. The difficulty lies not only in the impracticability of forming precise notions of the heat and light, which actually arrive at any given place in a given time; but in the utter impossibility of forming even a conjecture of those portions, which become latent or are otherwise lost in the passage of the solar rays through the atmosphere. The following observations will give some idea of the absolute quantity of light which reaches the earth; but it is proper to apprize the reader, that the results stated are to be considered as liable to much uncertainty.

* *Elémens de Physique expérimentalé et de Météorologie, tom. ii. p. 704.*

Nor do we now whether they are equally applicable to heat, which, though it obeys laws somewhat analogous to those of light, may nevertheless have its own peculiar laws.

A vertical ray of light, in its passage through the clearest air, has been calculated to lose at least a fifth part of its intensity before it reaches the earth's surface. From this cause, and from the actual condition of the atmosphere, it has been estimated that under the most favourable circumstances, of a thousand rays emanating from the sun, only 378 on a medium, can penetrate to the surface of the earth at the equator, 228 at the latitude of 45° , and 110 at the poles; while in cloudy weather these several proportions are a great deal less.*

At present, our attention is solely directed to those portions of heat and light which thus make their way to the earth's surface. On those portions retained in the atmosphere we shall offer a few remarks hereafter.

2. *Of the Distribution of Heat and Light over the Earth's Surface in the latent and decomposed Forms.* The distribution of heat and light in the *latent* state over the surface of the globe, probably follows laws nearly similar to those of the distribution of sensible heat and light formerly mentioned; that is to say, the quantity latent, like the quantity sensible, diminishes from the equator towards the poles. On this subject, however, we want the necessary data, even for forming an opinion, much less for determining the amount and the exact law of distribution; all of which must be left for future inquirers. But of the infinite importance of the latency of heat, in the economy of nature, the following brief remarks will serve to convey some notion.

Let us take the familiar instance of water, than by which important fluid, the influence of the latency of heat cannot perhaps be more strikingly exemplified. We formerly showed that the temperature of water in becoming solid on the one hand, and gaseous on the other, makes, as it were, a pause; and that these changes never take place abruptly. The consequence of this arrangement is, that ice and vapour are formed slowly and gradually, and as slowly and gradually again become water: while sudden transitions from one state to the other are thus entirely prevented. Were it not for this beautiful provision, we should be constantly liable to inundations, and other inconveniences, that would absolutely have rendered the world uninhabitable. It is impossible, therefore, to reflect upon the arrangement itself, or upon the means by which it has been effected, without being impressed with the most profound admiration, not only of the wisdom of the Great Designer of the whole, but of his goodness and benevolence.

The distribution of heat and light in the *decomposed* forms, like

* Article CLIMATE in the Encyclopædia Britannica.

the other conditions of these great principles, decreases from the equator towards the poles. We formerly alluded to the opinion that heat, whatever it may consist of besides, appears occasionally to be convertible into the electric and magnetic energies. This conversion, under certain circumstances, may be true of sensible heat; but heat, in the latent or combined form, is perhaps most liable to be so converted. Without pretending to offer any opinion, one way or the other, on this view of the nature of heat, we shall, nevertheless, adopt it for the sake of convenience, and shall, therefore, next consider the subject

Of the General Distribution of Electricity and Magnetism over the Earth. The recent discoveries on the connexion of electricity and magnetism, formerly described, have thrown much light on the distribution of these important agencies over the globe; and the present extent of our knowledge regarding them will be understood by the general reader from the following summary.

Every one is familiar with the ordinary phenomena of a magnetic needle freely suspended, and with its tendency to assume a position more or less approaching to parallelism to the earth's axis; that is to say, that all over the world it points nearly north and south. Most persons, probably, are also acquainted with the phenomenon termed the *dip* or *inclination* of the magnetic needle: thus, in the latitude of London, a needle exactly poised and freely suspended, instead of assuming a horizontal position, will settle at an angle of 70° , the north pole being downwards. If we carry such a needle southwards, towards the equator, we observe that the dip gradually diminishes; till at a certain point, nearly coinciding with the earth's equator, it has no dip at all, but assumes a perfectly horizontal position. As we still proceed towards the south, the dip again makes its appearance, but in an opposite direction, the south pole being now next the earth's surface. To understand the reason of this *dip* of the magnetic needle and of its general direction, we have only to consider that the earth itself is a magnet, the poles of which are situated beneath its surface. The directive property of the needle is owing to these poles; and when the needle is on the north side of the equator, the north pole of the earth having the greatest effect, the needle is attracted downwards, towards the north pole; hence, exactly over the pole the needle would be vertical. Similar phenomena happen in the southern hemisphere; but here the south pole predominates, and, of course, depresses the corresponding pole of the needle; while, at the magnetic equator, from the equal action of both poles, the needle will assume an exactly horizontal position. It may be remarked, that neither the magnetic poles nor the magnetic equator coincide exactly with those of the earth; and that this non-coincidence is owing to, or rather constitutes, what is termed the *variation* of the needle; which is not only different in different parts of the world, but appears to be liable to periodical differences in the

same place, at present not well understood. Such are the principal phenomena of the magnetic needle as demonstrative of the earth's magnetism, and which we shall now attempt to illustrate a little further.

We have mentioned, that the earth may be considered as a great magnet. Now, we have formerly shown that when a magnetic needle is in its natural position of north and south, there exist electrical currents in planes at right angles to the needle, descending on its east side, passing under it from east to west, and ascending on its west side. Hence, we must suppose currents of electricity to circulate within the earth, more especially near its surface, and to be constantly passing from east to west, in planes parallel to the magnetic equator; which electrical currents, if such can be demonstrated to exist, will in their turn completely account for the magnetic directive property of the earth. The next question is, therefore, how far we are justified in assuming the existence of such electric currents within the earth?

We have already alluded to the opinion that heat occasionally passes into the electric and magnetic energies; an opinion which some consider to derive much probability from the phenomena of what has been termed *thermo-electricity*; that is to say, electricity (and magnetism) developed by the unequal distribution of heat through bodies. Now, whether the phenomena of thermo-electricity actually depend on the decomposition of heat, latent or sensible, or upon any other cause, is of little importance; the phenomena themselves are well established, and they seem to account, in the most satisfactory manner, for the general distribution of electricity and magnetism over the earth. The explanation is this: the earth during its diurnal motion on its axis from west to east, has its surface successively exposed to the solar rays in an opposite direction, or from east to west. The surface of the earth, therefore, particularly between the tropics, will be heated and cooled in succession, from east to west, and currents of electricity, on thermo-electric principles, will at the same time be established in the same direction: now these currents once established from east to west, will, of course, give occasion to the magnetism of the earth from north to south. Hence the magnetic directive power of the earth, in a direction nearly parallel with its axis, is derived from the thermo-electric currents, induced in its equatorial regions by the unequal distribution of heat there present, and depending principally on its diurnal motion.

These recent and beautiful discoveries show, in the most striking manner, that the operations of nature are more extraordinary, and indicate more of simplicity and wisdom of design in proportion as they are better understood. By what simple expedients, when known, are those wonderful phenomena of the earth's electricity and magnetism produced, which formerly appeared so anomalous and

perplexing! And what encouragement do these discoveries hold out to us, with respect to future discoveries, that may throw still further light upon the operations of the Great Architect of the universe.

Of the Distribution of Light in the decomposed Form over the Globe. Every one is familiar with the general fact, that the most splendid exhibitions of colours of every description are displayed in the warmer climates; and that the tints of natural objects, generally speaking, become more sad and faded as we approach the colder regions, till they merge into the white of the polar snows. Most persons, also, are aware of the well known circumstances attending the total abstraction of light from plants and animals, and that they thus become more or less white or *etiolated*. Hence, we need scarcely do more than remind the reader, of what must be already familiar to him, viz., that the decided colours of tropical productions of every kind, whether we consider the gaudy plumage of the birds, or the variegated adornment of the fishes and insects, &c., are so striking, as to be quite characteristic of these productions. In the higher latitudes, also, where the contrast between the summer and winter seasons is very great, the colours of some animals vary with the seasons; being in the summer generally of some dark hue, but in the winter nearly white; while still further, in the polar regions all is more or less white, and the natural covering of the earth, the snow, is the whitest body in nature. Putting out of sight the great importance of the colours of objects, which will fall more naturally to be spoken of hereafter; it may be remarked here, that colours have usually been considered as offering to us one of the most striking instances of the benevolence of the Deity. Colours are universally agreeable to mankind; and the most incurious and ignorant are attracted by, and delighted with, showy exhibitions of them. Now, all this pleasure is the gratuitous gift of the Creator, and places his benevolence in the strongest possible point of view. There was no reason why man should have distinguished colours at all, much less have been delighted with them: but what is the fact? not only are we gifted with organs exquisitely sensible to the beauty of colours; but, as if solely to gratify this feeling, the whole of nature, from the highest to the lowest of her productions, forms one gorgeously coloured picture, in which every possible tint is contrasted or associated in every possible manner. Is there a human being who can witness the splendid colouring of the atmosphere above him by the setting sun; who can witness the beauty and endless variety of tint displayed by every object of the landscape around him, down to the minutest insect or flower or pebble at his feet; who is conscious of the pleasure he derives from these objects, and who reflects that this pleasure was not necessary to his existence, and might have been withheld? Is there, we ask, a human

being who duly considers all these things, and who will dare to assert that the Being who made them all is not benevolent?

3. *Of the Laws of Absorption, Radiation, and Reflection of Heat and Light.*—These laws as applied to the earth generally, are at present but very imperfectly understood. The following remarks will serve to convey some idea of the little we know on the subject.

The reader will bear in mind what was formerly stated, that the absorbing power of bodies with respect to heat (and perhaps light also) is *directly* as their radiating power, and *inversely* as their reflecting power. Such is the general opinion; and, as far as solar heat and light are concerned, this opinion appears to be well founded; but we shall see presently that there are strong reasons for suspecting that the radiating power does not always follow the same law as the absorbing power. In the mean time, however, we shall proceed to state what has been advanced on these points.

Mr. Daniell has attempted to show that the absorption and radiation of solar heat increase as we proceed from the equator toward the poles. Thus, in a tropical climate, and under a vertical sun, the greatest extent of the difference between two thermometers, the one covered with black wool, and exposed to the direct rays of the sun, in order that it may absorb to the utmost the incident heat, and the other, uncovered in the shade, is no more than about 47° ; while two thermometers, similarly circumstanced, in the middle of summer, in London, give a difference of 65° ; and in the Arctic regions the difference often amounts to 90° at least: so that in the Arctic regions there is twice as much heat and light absorbed under similar circumstances, as there is in the tropical regions. The same gentleman has also attempted to show (what might have been inferred indeed from the assumed relation between the absorption and radiation of heat and light above-mentioned), that the radiation of heat from the earth's surface obeys similar laws; that is to say, that the quantity radiated from the earth increases from the equator toward the poles. Laws somewhat analogous, and which, when they are better understood, will probably throw much information upon these phenomena, seem to hold with respect to light. Thus we formerly mentioned that when a ray of light falls upon fluids, transparent bodies, or metals, the quantity reflected *increases* with the angle of incidence reckoned from the perpendicular; while the quantity absorbed of course *decreases* in the same proportion: but that on the contrary when a ray falls upon *white opaque* bodies, the quantity reflected *decreases* as the angle of incidence increases; while, of course, the quantity absorbed, *increases* in the like proportion. Hence if heat follows the same law, it is evident that the quantity of heat absorbed by the earth from the solar rays, must *increase* from the equator towards the poles; that is to say, as the angle of their incidence increases, as Mr. Daniell has attempted to show. It is proper, however, to observe that Mr. Daniell's views

have been called in question, and that some late observations made in high latitudes do not entirely corroborate them.* We have alluded to the subject merely with the view of drawing the attention of Meteorologists to it as one of great interest and curiosity, and as one by no means at present understood. There is every reason to believe that the absorption (and perhaps the radiation) of heat and light, under some of its modifications, are much influenced by polarization, and consequently by certain angles of incidence and reflection; and that these circumstances, in consequence, have much to do with the distribution of heat and light, particularly in the higher latitudes, where they may exert no small influence upon organized beings. The above observations seem to point to the existence of certain general laws, which no doubt hereafter will be elucidated.

In noticing the influence of different colours on the absorption and reflection of heat and light, we stated that black and dark colours generally absorb most and reflect least; and *vice versa*, that white and light colours, reflect most and absorb least; and we are now come to illustrate this interesting subject, and to consider the following questions.—Why does whiteness prevail in the polar regions? Why, for instance, is snow white? On the contrary, why are all sorts of dark and decided colours met with in the tropical climates, except whiteness, which is comparatively rare? Might not snow have been black instead of white; which was just as likely if its colour had been the result of accident? or might not whiteness have been predominant under the equator? Perhaps the best mode of answering these questions, and of placing the subject in a striking view, is to examine what would have been the consequence, if whiteness *had* prevailed under the equator, and blackness at the poles.

As heat and light are supposed to obey nearly the same laws, as far as absorption, radiation, and reflection are concerned, it is obvious that if white had prevailed in the tropical climates, almost all the solar heat and light, instead of being absorbed, would have been reflected. The consequence of this reflection would have been, that the accumulation of heat and the glare of light in the lower regions of the atmosphere, near the surface of the earth, would have been intolerable, and would have rendered these regions quite uninhabitable, at least by the present race of beings. The surface of the earth, also, though it would have been heated slowly, would

* We allude here to the observations made in those regions, and given in the appendix to Captain Franklin's Second Journey, by Dr. Richardson, Captain Back, and Lieutenant Kendal. In these observations Dr. R. states that the radiation was much stronger in the spring months, *when the ground was covered with snow*, than in the summer months, when the altitude of the sun was greatest. Dr. R. ascribes this greater radiation to the greater clearness of the air at these seasons, but were there no other reasons?

have been overheated in time; and at length would probably have become so very hot, from its comparatively low radiating powers, that the heat could not have been borne. As it is, the heat and light of the sun are absorbed readily, and as freely given off again by radiation; or perhaps the heat, like the light, is decomposed; and thus the whole is preserved in that comparatively moderate and nicely balanced state, which renders even the hottest parts of the earth inhabitable.

On the other hand let us consider for a moment what would have been the consequence if snow had been black, or in other words, if blackness had prevailed in the polar regions. In this case, all the little light and heat that reach them would have been absorbed, and the effect would have been darkness, more or less complete. From the rapid melting also of the snow on the least exposure to heat and light, we should have been constantly liable to inundations. Thus the whole of the polar regions of the earth would have been one dark and dreary void, inaccessible to organic life. But by the present arrangement, all these consequences are obviated. The white snow absorbs a certain portion of light and of heat (by a beautiful provision *more* as the angle of incidence increases?) while so much light is reflected as is useful, and no more.* Thus the adjustment of the colours of bodies to the circumstances in which they are placed, constitutes an example of the expedients by which those minor incongruities are obviated, that are necessarily incidental to the modes in which heat and light are distributed over the globe; and presents altogether one of the most obvious and beautiful instances of design connected with the agency of heat and light.

Lastly, it may be worth while to draw the attention of the reader to the striking contrast displayed between the ponderable and imponderable forms of matter, as to the ease with which they are decomposed, and the modes in which they exist in nature.

We have seen that to preserve the homogeneity and integrity of ponderable bodies, as of water and air, elaborate arrangements have been adopted, evincing the most extraordinary design and wisdom; because the decomposition or derangement of water and air would at once prove destructive to organized beings. But, to preserve the homogeneity of heat, and particularly of light, no such care is shown,

* The reader will observe that, under ordinary circumstances, *white* reflects most and of course absorbs and radiates *least* solar heat and light; but if the above remarks on light be well-founded, the absorption of light (and heat?) by white bodies *increases* with the angle of incidence. Now, as nothing of this sort is known, or can be well conceived to happen, with respect to radiation, the doubt expressed at the beginning of this section arises, viz., whether under all circumstances, the radiating and absorbing powers of bodies obey similar laws, even as far as the solar rays are concerned. The absorption and radiation of heat of low intensity, and unaccompanied by light, seem to depend more upon the nature of the surface than upon colour. It must be admitted, however, that at present a great deal of obscurity hangs over the whole of this subject.

because no such care was particularly necessary. The decompositions of these agencies, therefore, are permitted to take their natural course; and by an admirable provision, so far are colours, magnetism, &c. from being injurious to us, that they constitute one of the chief sources of our knowledge and happiness!

4. *Of the Conduction of Heat below the Earth's Surface on Land.* The soil, from a few inches to a foot or more below the surface, participates very much in the fluctuations of the surface temperature. In general, perhaps, it may be stated, that the temperature of the surface of the earth is a little above that of the incumbent atmosphere by day, and below it by night; though much will depend in this respect upon the nature of the soil, on its radiating and conducting powers, and on a multiplicity of other conditions that will readily occur to the reader. At a certain distance, however, below the surface, and varying with the latitude and other circumstances, there must be a determinate stratum, where the temperature is uniform, or nearly so, throughout the year. Experiments on this subject are very limited; but there is reason to believe, that the temperature of this *invariable stratum* coincides nearly, with the mean annual temperature of the place; and that its depth below the surface, in different latitudes, varies between forty and eighty feet. The reader need scarcely be reminded, that the well known uniformity of the temperature of cellars and caves, depends chiefly upon the circumstances we are now considering. As an instance of the uniformity of temperature in such places, it may be mentioned, that a thermometer placed in the caves under the observatory in Paris, at a depth of about eighty-five feet below the surface, has, during fifty years, scarcely varied more than a quarter of a degree from 11.82° of the centigrade scale; equal very nearly to $53\frac{1}{4}^{\circ}$ of Fahrenheit.

A few experiments have been made to determine the variation of the temperature, throughout the year at different depths from the surface, down to the invariable stratum; and the following is a summary of the results, which, perhaps, may be considered as generally applicable to the northern hemisphere.

In the month of August the temperature of the earth goes on decreasing in nearly a uniform manner, from a little below the surface to the stratum of invariable temperature. In the month of September the temperature is nearly uniform to fifteen or twenty feet below the surface; beyond which depth the temperature decreases a little and slowly to the stratum of invariable temperature. During the months of October and November the temperature increases from the surface to the depth of fifteen or twenty feet; and below this point it remains nearly uniform to the invariable stratum. During December, January, and February, the temperature, being at its minimum upon the surface, increases in a manner nearly uniform, downwards to the invariable stratum. During March and April there is a rapid decrease of temperature to the depth of one or two

feet; below this depth the temperature decreases less rapidly: and still lower, the temperature increases a little. During the months of May, June, and July, the temperature being at its maximum, at the surface, decreases downwards, but less rapidly and to a greater depth; it then begins to increase a little till it attains the temperature of the invariable stratum. The rapidity and degree, however, with which these changes take place, as well as the changes themselves, appear to fluctuate very considerably not only in different places under the same Isothermal line, but in the same place in different seasons.

Since heat is propagated through the soil by conduction, of course it is propagated in all directions. Hence, it may be supposed to move laterally as well as downwards; and, generally speaking, the temperatures of contiguous spots probably tend to equalize each other. But upon the whole, the influence of the lateral propagation of heat through the solid parts of the earth, must be very limited.

5. *Of the Propagation of Heat and Light below the Earth's Surface in Water.* Water is a very imperfect conductor of heat in the usual acceptation of the term. Thus, almost any degree of heat may be applied, for a considerable time, to the upper surface of a mass of water, without materially influencing the temperature below; so imperfectly and slowly is heat conducted through this fluid. The process by which heat is communicated through water, we have termed *convection*. When heat is applied to the bottom of a vessel full of this fluid, the portion of the water first heated expands in bulk, and thus becomes specifically lighter; it then rises to the top, carrying with it the newly acquired temperature, while another cold portion, sinking to the bottom, is heated in turn, and so on, till the whole mass becomes uniformly heated.

With respect to the propagation of light through water, it has been calculated that not a tenth part of the incident light can advance five fathoms downwards in the most translucent water; that even of vertical rays, one half is lost in the first seventeen feet, and that they become reduced to one-fourth by traversing thirty-four feet, which correspond to the mass of an atmosphere. It thus follows, that only the hundred thousandth part of the vertical rays can penetrate below forty-seven fathoms, which is scarcely equal to the glimmer of twilight; and that the depths of the ocean must be always in perpetual darkness.*

Such are the general principles by which heat and light are propagated in water. But in speaking of this fluid in a former chapter, we alluded to one of the physical properties of water, of the utmost importance in the economy of nature, and which, perhaps, almost more than anything else, indicates design; since, like the composition of the atmosphere, this property of water constitutes an excep-

*Article CLIMATE, in the Encyclopædia Britannica.

tion, as it were, to a general law, expressly directed to a particular object. We have mentioned that it is a general law, that all bodies, in every state of aggregation, expand by heat and contract by cold; now water forms a marked exception to this law. Like other bodies, water continues to contract on the removal of heat, till its temperature comes down to within a certain distance (7° or 8°) from its freezing point. At this distance, water begins again to expand, and the expansion continues till it becomes ice; at which moment of freezing, a sudden and considerable expansion takes place. Hence, the specific gravity of ice is decidedly less than that of water, and the solid necessarily swims on the surface of the fluid. The importance of this anomalous property of water is so great, that it is doubtful whether the present order of nature could have existed without it, even although everything else in the world had remained the same. For instance, were it not for the comparative lightness of ice, this solid, instead of beginning to be formed at the *surface* of water, would have begun to be formed at the *bottom*; as the colder water from its greater specific gravity would naturally have sunk: for similar reasons, also, the lower stratum of ice would have been the last to have melted. Now, let us reflect for a moment upon the consequences of such an arrangement. In the northern and indeed even in temperate climates, the bottoms of all lakes and deep waters would have been a mass of ice, and totally inaccessible, therefore, to organized beings. During the summer a few feet of the upper part of the ice, would, perhaps have been melted; but what little had thus become melted in summer, would again have become solid during winter; and as the accumulations of ice would have been constant, all the seas, even perhaps to the tropical climates, at least at their bottom, would, long before this time, have been a mass of ice! But what in reality happens? In consequence of the above anomalous properties of water, this mischief is entirely prevented, and not a particle of ice can be formed in a lake or other collection of water, till the whole mass is cooled down to the temperature of 40° , at which temperature the specific gravity of water is at its maximum.

These properties of water operate in the following manner. On the application of cold to the surface of water, the cooled portion sinks, and its descent forces up a portion of warmer water to the surface, which after communicating some of its heat to the superincumbent air, sinks in its turn; and this process goes on for a greater or less time according to the depth of the water. If the depth be not very considerable, the whole body of water becomes cooled down to 40° ; at which temperature the specific gravity not increasing, the circulation ceases, and the *surface* of the water, (not the *bottom*) becomes at length so far cooled as to be covered with ice. If the depth of the water be considerable, the application of cold may be long continued without the result of freezing; hence,

in this and in other countries, not intensely cold, it often happens that deep lakes remain unfrozen during the coldest winters.

The above anomalous properties of the expansion of water and its consequences, have always struck us as presenting the most remarkable instance of design in the whole order of nature—an instance of something done expressly, and almost (could we indeed conceive such a thing of the Deity), at second thought, to accomplish a particular object. Further, if in conjunction with this anomalous property of water, we take into account the still more anomalous constitution of atmospheric air, and at the same time consider the relations of water and air to organic existence, we are unavoidably driven to the conclusion, that the Maker of water and of air has designedly created these anomalies, to obviate difficulties which would have rendered organic existence a physical impossibility. Thus, had means not been taken to secure the fluidity of water under the varying circumstances of temperature in which it is placed: the greater portion of this fluid in the world would long ago have been a solid mass of ice, and consequently inaccessible to organic life. Had means not been taken to secure the homogeneity of air at all times, and under all circumstances, this important medium would not only have been constantly liable to local deteriorations; but its properties, long ere now, would have probably become deteriorated to such a degree, as to have rendered the permanence of organic life not less physically impossible. Nor do the suppositions which the sceptic will urge, that these properties of water and air flow naturally from their constitution, diminish the force of the argument. The force of the argument lies, in the first place, in the fact that water and air have been created with such anomalous properties; and, in the next and chief place, *that these anomalous properties have been brought into action precisely where they are required.* Moreover, the argument is greatly strengthened, by the fact that *two anomalies*, rather than that *two ordinary circumstances*, have been thus expressly adjusted.

Having stated the general principles on which heat is distributed through water, and its most remarkable consequence; we are now to enter into a few details with respect to some other consequences of this distribution. Of these one of the most striking is, that the temperature of the water at the bottoms of deep lakes or inland seas, must remain nearly uniform during the whole year. Thus it has been found that the temperature of the water at the bottoms of many of the lakes in Switzerland often varies no more than 3° or 4° , while the temperature of the surface often varies 20° or 30° . Hence in deep waters, in temperate climates, the changes of temperature are chiefly confined to the upper strata of the water; nor can ice (except from some very sudden and powerful accessions of frost) form on the surface of such a lake, till, as before observed, the whole of the water in it is cooled down to 40° , at which temperature all cir-

culation ceases. When a coat of ice has been once formed, this ice, as we shall see presently, has also a powerful tendency to prevent the further cooling of the inferior strata.

With respect to *waters in motion*, as small streams, or rivers of no great depth and magnitude, and containing fresh waters; though unfavourably circumstanced for freezing, they do nevertheless congeal. The process usually commences at the shores where the water is shallowest, and its motion is least rapid; from whence the ice gradually advances towards the centre of the stream. When the whole of the surface has once become fixed, congelation goes on actively, particularly by night. As the thickness of the ice increases, however, the quantity added daily, even supposing the cold to remain the same, gradually diminishes, on account of the bad conducting power of the ice. Hence in a block of ice taken from a river or lake, we may often observe the strata corresponding with the daily, or rather nightly additions, presenting a gradually decreasing series from several inches down to a few lines in thickness.

Of the Temperature of the Waters of the Ocean at great Depths.—Between the Tropics, the temperature of the ocean diminishes with the depth; in the Polar seas, on the contrary, the temperature augments with the depth. In the temperate seas, comprised between 30° and 70° of latitude, the temperature of the water gradually decreases as the latitude increases, until about the latitude of 70° ; when the temperature begins to rise as before mentioned. Hence about the latitude of 70° there exists a zone or band at which the mean temperature of the ocean is very nearly constant at all depths. The temperatures of particular parts of the ocean, however, have been observed to be much influenced by the depth and extent of the water, particularly in high latitudes.

We have already mentioned the influence of the saline matters of the ocean upon the *freezing point of sea-water*, and we have now to point out the important consequence of this property in the economy of nature. In its natural state sea-water freezes at about 28° or 29° , but when it has been concentrated by previous freezing the congealing point is reduced to 15° or 16° ; while water saturated with salt, it is said, does not freeze at a temperature above 5° . Besides this property of lowering the freezing point of sea-water, the saline matters also increase its specific gravity and its point of maximum density. Hence from these circumstances, and from their immense depth and extent, the waters of the ocean resist freezing still more effectually than even running fresh water, and are indeed rarely frozen, except in latitudes where the most intense cold prevails.

Of the under Currents of the Ocean existing between the Equatorial and Polar Regions.—That the diminished temperature of the waters of the ocean, at great depths near the equator, could not have been acquired in the torrid zone, is evident; nor, on the other hand, could the comparatively high temperature of the waters, at the bot-

tom of the Polar seas, have been acquired in the frigid zone; at least this high temperature of the Polar seas cannot be caused from without. Hence it has been supposed that there is a constant interchange going on between the waters of the Equatorial, and those of the Polar regions; though there are considerable difficulties at present as to the means by which this interchange is effected. These difficulties arise principally from some uncertainty with respect to the point of maximum density of sea-water, which does not appear to be satisfactorily established. Whether in the profound and comparatively quiescent abyss of the ocean, the process of diffusion, or the central heat of the earth formerly alluded to, exert any influence, we have no means of determining. But if a central heat really do exist, its effects must be considerable, particularly within the frigid zone. Whatever be the cause of this approach to uniformity of temperature throughout the waters of the ocean, at great depths all over the globe, its use in the economy of nature, in tending to equalize the distribution of temperature, cannot be questioned; since it constitutes one of those beautiful provisions by which the difficulties of the distribution of temperature, necessarily incidental to the earth's figure and motions, are obviated; whilst among the minor circumstances contributing to the same end, may be mentioned the tides and the innumerable superficial currents produced by winds and by other causes which are to be considered elsewhere.

We have alluded, in a former chapter, to *the difference of temperature as depending upon whether the surface be land or sea*; and perhaps it may not be amiss, in this place, to make a few remarks upon the actual general amount of the differences of temperature, as produced by land and water.

In the middle of oceans, and far from the influence of land, the diurnal change of temperature of the air near the surface of the sea is much less than upon land. Thus, in the equatorial regions the greatest difference between the temperature of the day and that of the night at sea is said to amount to 3° or 4° only; while upon land the difference often amounts to 9° or 10° . In temperate regions, and particularly in latitudes extending from 25° to 50° , the difference between the maximum and the minimum diurnal range of the thermometer at sea is still very trifling, amounting only to 4° or 6° ; while upon the continents, as for example, at Paris, the range often amounts to 20° or 30° . To these circumstances it is owing that small insular situations, partaking of the character of the surrounding ocean, are much less liable to great diurnal changes than continents; and hence, in general, they possess more equable climates.

Both by sea and land the minimum temperature takes place about sunrise. The maximum temperature at sea occurs about noon, or very soon after; while upon land it takes place from two to three hours after noon. Between the tropics the maximum temperature of the air is said to exceed a little that of the surface of the sea.

But when the temperatures are observed at short intervals, as for example, every four hours, and all the temperatures are compared, the results are different; and they seem to show that even between the tropics the temperature of the surface of the sea is higher than that of the incumbent atmosphere. Between the latitudes of 25° and 50° the air is rarely warmer than the surface of the sea; and in the Polar regions it is very unusual to find the air as warm as the sea; it is in fact almost always colder, and generally very much colder.

As connected with this part of our subject, it may perhaps, before we close, be desirable to offer a few remarks upon *the temperature of natural springs*, and their relation to the mean temperature of the earth at the places where they make their appearance.

Springs discharging large quantities of water, and thus indicating that they come from considerable depths below the surface of the earth, preserve nearly the same temperature during the whole year. In our hemisphere, what little augmentation of temperature springs undergo, is generally in the month of September, while they are coldest in the month of March; though the differences seldom exceed two or three degrees. If we compare the temperature of the springs of any place, with the mean annual temperature of that place, we find that there is a near connexion between the two, all over the globe. In the torrid zone, however, the mean annual temperature of the air is usually higher by three or four degrees than that of the springs; while in the temperate zone, on the contrary, the springs are warmer than the air. The excess of temperature of springs, as compared with the mean annual temperature, goes on increasing with the latitude; so that, between 60° and 70° of latitude, this excess amounts to from 5° to 7° ; a circumstance we shall again have occasion to notice. Other things being the same, the temperature of springs varies considerably according to their copiousness; as a large body of water will be less liable to be influenced by the surrounding soil, than a smaller body of water; and may even, in turn, influence the temperature of the soil itself.

The subject of *thermal springs*, as intimately connected with the history of volcanoes, belongs to the Geologist.

We have thus enumerated the principal circumstances connected with the distribution of temperature upon the surface of the earth, and at such parts below it as are within our reach. We now come to the second great division of the subject of climates; viz., that connected with the atmosphere.

SECTION II.

Of the Secondary Constituents of Climate immediately connected with the Atmosphere.

THE phenomena of the atmosphere originally constituted the proper study of the Meteorologist, and even yet they claim the largest share of his attention. The subject, in all its bearings, is very extensive, and many of the details are imperfectly understood. We shall endeavour to present a brief outline of the principal phenomena under the following heads.—*Of the distribution of heat and of light through the atmosphere, and of the consequences;—of the distribution of water through the atmosphere, and of the phenomena dependent upon this distribution; and, lastly,—of the occasional presence of foreign bodies in the atmosphere.*

1. *Of the Distribution of Heat and of Light through the Atmosphere, and of the Consequences.*—Every one is familiar with the general fact of the diminished temperature of the higher regions of our atmosphere; and that in the hottest countries, by ascending a lofty mountain, we encounter, at different heights, every variety of temperature, even to that of perpetual snow, and of the Polar regions. One of the first circumstances, therefore, that claims the attention of the Meteorologist, is the law of *the distribution of sensible heat, or of temperature, through the atmosphere.*

The law of the distribution of temperature through the atmosphere is tolerably uniform, though it is occasionally liable to variations and interruptions, depending upon local differences, and perhaps upon other circumstances, not satisfactorily understood. The mean results of a great number of observations made in different parts of the world appear to show, that for every 100 yards of altitude, Fahrenheit's thermometer sinks one degree. This statement, probably, does not, within moderate limits, differ much from the truth; though some late researches have rendered it probable that while at different heights the rate of the decrease of temperature is uniform, the rate of altitude increases constantly, and according to laws very similar all over the world; that is to say, supposing the first 252 feet are equal to one degree, the second degree will be equal to 255 feet, the third to 258, the fourth to 261, &c.

The causes upon which this great cold of the higher regions depends are chiefly the two following; first, the perfect permeability of the atmosphere to the solar rays, on which account they radiate through it almost without affecting its temperature, till reaching the earth they exert their utmost force; and, secondly, the increased capacity for heat which air possesses in proportion as it becomes more rare. From the first of these causes it happens that the tem-

perature of the lower regions of the atmosphere is derived, not immediately from the sun, but from the earth. The earth absorbing the solar heat, recommunicates it to that portion of the atmosphere immediately incumbent on the surface, while all the atmosphere above remains unaffected; for though, from diminished specific gravity, heated air naturally ascends, yet as its capacity for heat at the same time increases, ascending air rapidly loses its sensible heat: as in the second place we have to explain.

Dr. Dalton, and afterwards Sir John Leslie more completely, have attempted to show that the equilibrium of heat in the atmosphere is obtained *when each of its molecules, or in other words, when the same weight of air, in the same perpendicular column, is possessed of the same quantity of heat.* Now, since atmospheric pressure diminishes with the height according to a certain law, it is obvious that the *same weights of air* at the surface of the earth, and in the higher regions, will occupy *very different spaces.* But since the absolute quantity of heat is exactly the same in both portions, it is likewise obvious that in the higher regions of the atmosphere, from the increased capacity of the air for heat, the quantity of latent heat is gradually augmented, while the quantity remaining sensible, becomes less. Hence the temperature of the air diminishes as we ascend, exactly in the proportion that its latent heat, that is to say, its capacity for heat as produced by rarefaction, increases. In consequence of this arrangement, to use the words of Dr. Thomson, "if a quantity of cold air were suddenly transported from an elevated region to the surface of the sea, its density would be continually increasing during its descent, while its latent heat would diminish in the same proportion; and when it reached the level of the sea its temperature would be just as high as that of other portions of air in the same latitude and elevation. Air, therefore, does not feel cold in consequence of falling from an elevated situation, though this be an opinion commonly entertained, but in consequence of its being suddenly transported from a more northerly to a more southerly situation."* Thus, to the above beautiful and simple law, we owe the permanent state of equilibrium of temperature in the atmosphere; for, in spite of all the disturbances constantly produced by minor causes, this equilibrium, from the natural tendency to right itself, is never very seriously affected.

Of the Limits of Perpetual Snow.—Connected with the diminution of temperature in the higher regions of the atmosphere are the *limits of perpetual snow* in different latitudes. These limits, of course, may be naturally supposed to follow the mean temperature of 32° , from the level of the sea in the Polar regions to the highest point of their range under the equator. This inference is obvious, and, generally speaking, correct; though it is liable to certain modifications, and to some anomalies, of which the following are the most remarkable.

* On heat and electricity, p. 129.

Under the equator the limits of perpetual snow are the most fixed and steady, and seem to exist generally at an altitude of between 15,000 and 16,000 feet. As we recede from the equator, the oscillations for the most part become more striking, and all the phenomena assume a more irregular form. Such, for example, is the case in the Mexican Cordilleras; but still more evidently in the Himmala range, where there is a difference of no less than 4000 feet between the limits of perpetual snow on the northern and on the southern sides of the mountain, that on the northern being the highest. As we proceed towards the temperate zones, we find, in mountainous countries, below the limits of perpetual snow, immense bodies of ice, or *glaciers*, as they are termed. These glaciers are formed by the alternate melting and congealing of the extensive beds of snow that lie above them. The glaciers, accumulating in valleys, are often by the enormous and increasing weight of the snow and ice in the upper parts, pressed downwards far beyond the limits of the snow itself. Such are the *glaciers* of Switzerland, of Norway, and of other countries in temperate climates. All these circumstances, with others that might be mentioned, and many probably that are unknown to us, combine to render the limits of perpetual snow irregular. These irregularities are so great, that Humboldt has given as a mean of many observations, that at the equator the limits of perpetual snow are nearly 3° above the freezing point, while in the temperate zone they are nearly 5° below that point, and in the frigid zone no less than 10° or 11° below freezing; which observations seem to prove that the general temperature of the air decreases in the equatorial, otherwise than in the colder regions. From the peculiar distribution of the land in the southern hemisphere, little is known of the line of perpetual snow in that part of the world; but it will probably be found to be different from that in the north, and generally lower.

The perpetual snow resting on the tops of mountains constitutes a most important provision in the economy of nature, particularly in the warmer climates, where the accumulated snow becomes the prolific source of innumerable rivers without which these regions would be uninhabitable.

There is a striking difference between the elevated and the lower regions, which must have considerable influence upon organization, though this influence has not been studied so carefully as it ought to be; viz., the difference of atmospheric pressure. At the surface of the earth, the atmospheric pressure is nearly the same in all latitudes, but as we ascend above the surface, the pressure rapidly diminishes. Everything else, therefore, being supposed to be the same, the difference of pressure is probably alone sufficient materially to influence organization, and to render certain provisions and accommodations necessary, of which, at present, we are ignorant; but which might

be doubtless much elucidated by a careful study of Alpine plants and animals, as compared with those that occupy the plains.

Of the Distribution of Heat and Light through the Atmosphere in their latent and decomposed Forms.—In the preceding paragraphs we have alluded to the quantity of heat existing *latent* in the higher regions of the atmosphere. But besides this quantity, which may be supposed to be common in the whole atmosphere, the distribution of latent heat and light must in some degree follow the same law as that of sensible heat and light; that is, must decrease from the equator toward the poles. Thus there can be no doubt, that the expanded air of the equatorial regions contains much more heat and light in the latent state, than the comparatively dense and dry atmospheric air of the Polar regions; and it is probable that the rigours of each extreme are mitigated by this provision. The distribution of electricity through the atmosphere seems also to be regulated by very similar laws. It may, however, be remarked that the effects of heat and light, in the latent and decomposed forms, are much more striking as connected with the water in the atmosphere, than with the constituents of the atmosphere itself. We shall, therefore, defer what we have to say on those subjects till we speak of the water in the atmosphere.

Of the Propagation of Sensible Heat through the Atmosphere.—As the diffusion of gaseous bodies through each other is so far a mechanical process that it is regulated solely by the relations of their specific gravities, it follows that under the same pressure, different portions of the same gas, having different temperatures, and consequently different specific gravities, will have a similar tendency to diffusion. Hence, independently of all other circumstances, the warm and light air of the equatorial regions has a natural tendency to diffuse itself toward the poles; while the colder and heavier air of the poles possesses a similar tendency to diffuse itself towards the equator, though in a greatly mitigated degree. The exact amount of these tendencies we have no means of estimating, but they, doubtless, exert considerable influence; and, as the diffusive power may happen to coincide with, or oppose the atmospheric currents, to be next considered, it may augment or diminish their effects.

Though diffusion be thus largely concerned in the lateral propagation of temperature through the atmosphere, this propagation is evidently affected to a much greater extent by the process termed *convection*. Convection, like diffusion, of course, implies motion or currents; which currents as existing in the atmosphere, we need scarcely observe, are denominated *Winds*. The winds, therefore, are of the utmost importance in the economy of nature, as tending to equalize the distribution of temperature over the globe; and the following brief explanation will serve to give a general knowledge of their nature.

Atmospheric currents may be considered under two heads: those

of a general kind, and which extend more or less over the whole globe; and those depending upon various transient derangements of the distribution of temperature, the effects of which are limited to particular localities. On each of these we shall make a few remarks.

The *general currents* of the atmosphere depend principally upon the two following circumstances, which, if borne in mind by the reader, will furnish him with a clue to the whole subject: viz., the unequal temperature of the equator and of the poles; and the diurnal motion of the earth upon its axis. The convective operation of the first of these general causes may be thus illustrated. We have stated that the entire pressure of the atmosphere all over the earth's surface is nearly the same, and equal to that of a column of mercury about thirty inches in height. We have also stated that the mean temperature of this atmosphere near the equator, and at the level of the sea is upwards of 80° , while in the Polar regions it is constantly below 32° , the freezing point of water. Hence, as air expands by heat, and becomes specifically lighter, it is obvious that a given bulk of air at the level of the sea round the poles, must be considerably heavier than a similar bulk of air at the level of the sea under the equator. The air, therefore, round the poles being colder and heavier, will have a tendency to flow along the earth's surface from the poles towards the equator, and to displace the lighter air under the equator; while the equatorial air so displaced, will, owing to its lightness, ascend and flow back again over the colder air, north and south toward the poles, so as to preserve the equilibrium. Moreover these currents will be perpetual; for the heat of the equator and the cold of the poles being constant, the same tendency to change will always exist, and thus the currents will be constant likewise.

These atmospheric currents constitute one primary element of the winds, and are the grand means by which the equalization of temperature over the globe is effected. If the earth were at rest, and its surface free from irregularity, these currents or winds would, of course, be in the northern hemisphere always due north, and in the southern hemisphere due south; while the velocity would in each case gradually diminish from the poles towards the equator, where there would be a perpetual calm.

But the earth is in a constant state of motion upon its axis from west to east, by which motion the currents are deflected from their northern and southern course towards the east; and this eastern deflection constitutes the other primary element of the winds to be next considered.

On the surface of a globe revolving like the earth on its axis, the general reader will bear in mind that the motion of any given point at the equator is the *greatest*, and at the poles the *least* possible. Thus while the poles are quiescent, the velocity of any given place at the equator of our earth, is about 1000 miles an hour; from which

extreme, the velocity gradually diminishes toward the poles. This motion of the earth on its axis operates in the production of an easterly current in the atmosphere as follows. Supposing there were no atmospheric currents from the north and south towards the equator, and that the earth revolved upon its axis as at present, one of two things must happen. Either the earth during its revolution would carry with it the incumbent atmosphere; in which case there would be a perpetual calm over its surface: or the earth would revolve within the atmosphere, leaving, as it were, the atmosphere behind it; in which case there would be an apparent current or wind over the whole of the earth's surface, in a direction opposite to that of the earth's motion, that is from east to west; which wind, supposing the atmosphere did not move with the earth, would, of course, be at its maximum at the equator. Now both these causes are continually operating, and give origin to all the variety of the eastern currents upon the earth's surface, which, with the northern and southern currents, before described, conspire to produce the well known currents called *the trade winds*. Before we attempt to explain the trade winds, their phenomena may be thus briefly described.

The trade winds in the Atlantic ocean extend to about 28° on each side of the equator. At their extreme northern and southern boundaries these winds generally blow from the east; but as they proceed towards the equator from the north and from the south, they gradually pass from the east through all the intermediate points of the compass, till near the equator they become in the northern hemisphere, due north, and in the southern hemisphere due south. The trade winds are subject to some slight variations chiefly arising from the position of the earth with respect to the sun. On these variations we do not think it necessary to enlarge. The general phenomena are as we have stated them, and they, upon the principles advanced, appear to admit of the following explanation:

In the temperate regions of the earth the winds seem to obey no certain laws; at least laws so determinate as those of the trade winds. But about the tropics, both in the northern and in the southern hemispheres, the operation of the double currents and motions before described, becomes distinctly perceptible. Thus about the tropics, the surface of the earth begins to move faster than the incumbent atmosphere; and hence in these regions, the prevailing currents are from the east. Indeed near the tropics the currents are nearly due east, principally on account of the great and somewhat sudden change of temperature produced by the vertical sun of the tropical regions; which may be supposed to interfere with, and perhaps to check momentarily, the regular progress of the great northern and southern currents. As we proceed, however, towards the equator, in both hemispheres, the atmosphere gradually acquires the velocity of the earth, while the intensity of the eastern current

diminishes in the same proportion, and at length entirely disappears. At the same time the currents from the north and the south continuing, slowly deflect the currents, from the east towards the north in the northern hemisphere, and from the east towards the south in the southern hemisphere, till left alone by themselves the polar currents proceed onward to the equator, as if the motion of the earth had no existence.

The first clear and satisfactory theory of the great atmospheric currents or winds was given, we believe, by Mr. Daniell. The theory of the winds was subsequently illustrated by Captain Basil Hall, in his interesting essay on the trade winds, to which for details we must refer the reader.* Before we quit this subject we may remark that Mr. Daniell traces to these great currents the fluctuations of the barometer, and all the innumerable modifications peculiar to different localities of sea and land, of mountain and plain. For, as he justly observes, in the nicely balanced state of the forces producing these currents, slight irregularities of temperature are capable of causing great disturbances; and expansions and contractions acting unequally upon the antagonist currents, operate by deranging the adjustment of their several velocities. Hence accumulations in some parts, and corresponding deficiencies in others, necessarily arise; and occasion fluctuations in the barometer, far surpassing what would be occasioned by the whole vapour, supposing it were at once added or annihilated. At the same time these irregular distributions, in seeking to regain the proper level, and in struggling to restore the equilibrium, produce temporary and variable winds, which modify the regular currents and often reverse their courses, particularly in the temperate regions; where, as formerly mentioned, the alternations of temperature, and the fluctuations of the barometer, are the most remarkable.

Such are the elements of the general currents pervading our atmosphere, and such the modes in which these currents obviate extreme temperatures and their consequences. The same causes are constantly operating in different forms and degrees, so as to produce all the infinite variety among the winds, which we observe in nature. These are so numerous and diversified, as actually to baffle all attempts at explanation or arrangement; we shall therefore content ourselves with one instance only, by way of illustration, viz., *the sea and land breezes*.

The explanation of what are denominated the sea and land breezes is very obvious, and is not less applicable to many similar phenomena. During the day, the surface of the land acquiring heat, imparts its temperature to the incumbent air. This air expanding in bulk becomes specifically lighter, and rises in conse-

* See *Meteorological Essays and Observations*, by J. F. Daniell, Esq., Professor of Chemistry in King's College, &c., page 465, second edition.

quence; while the cooler air from the surrounding sea rushes in to supply its place, and thus produces the current called the *sea breeze*. During the night, on the contrary, the waters of the ocean part with their heat much more slowly than the land, and the reverse action, or the *land breeze* takes place. In hot climates near the seashore, and in insular situations, these alternations constitute a most agreeable variety.

2. *Of the Presence of Water in the Atmosphere.*—In the foregoing section we have endeavoured to give an outline of the beautiful provisions that have been adopted to prevent, by means of the air of the atmosphere, the consequences necessarily arising from the unequal distribution of heat and light over the globe. We now come to another subject of not less importance, viz., the phenomena depending upon the existence of water in the atmosphere, and which, taken together, principally constitute what we emphatically denominate *the Weather*.

Of the Relations of the Water in the Atmosphere to Temperature.—We have before stated the fact, that water has a tendency to assume the elastic form at all temperatures. From the tendency of water, thus to rise “above the Firmament,” not only the ocean, but ice and snow, are unceasingly contributing their supply of moisture to the air; and this important fluid, so indispensable to vegetable and animal existence, is distributed over the surface of the whole earth. In considering, therefore the relations of the water of the atmosphere to temperature, the phenomena which first claim our attention, are the processes by which water is taken up and again separated from the atmosphere; that is to say, the processes of *Evaporation* and *Condensation*.

In treating of the nature of *Evaporation*, the questions to be answered at the outset are,—Why is moisture present in the atmosphere? By what force is its presence determined, and its quantity limited? The reply to these questions depends upon the properties of matter in general, and of vapour in particular, as formerly described; which, if the reader bears in mind, will enable him readily to understand what follows.

When water is exposed to the air in an open vessel, the molecules of its uppermost or superficial stratum, being released from the influence of those below them, have a natural tendency to assume that degree of polarity which is appropriate to their temperature. Hence, after acquiring the latent heat necessary to produce this polarity, either at the expense of a portion of their own sensible heat, or that of the atmosphere, the superficial molecules of water become self-repulsive, and fly off into space in the form of vapour. If the space over the water be circumscribed and be a vacuum, the molecules fly off with such rapidity as instantaneously to fill it. But, if the space be occupied by air, or be of indefinite magnitude, the molecules fly off more slowly, so as gradually to diffuse themselves

through the whole space; quite on the same principle, and in the same manner, that one gaseous body is diffused through another.

Such, in few words, may be deemed a simple statement of what evaporation is. We shall next proceed to inquire into the nature and operation of the means by which evaporation not only takes place, but is limited within certain boundaries.

In a former chapter, we remarked, that the elastic force exerted by all bodies in the gaseous state bears a certain relation to their temperature, but that the degree of this elastic force varies according to other circumstances; particularly according to whether the gaseous body, at the given temperature, be capable of existing in the fluid or in the solid states, as well as in the gaseous state. Thus, atmospheric air, at the temperature of 32° (and indeed at all known temperatures), is a gaseous body, and, under ordinary circumstances, exerts an elastic force equal to the weight of a column of mercury 30 inches high; whereas, at the same temperature of 32° , water is a solid, and the force of the elasticity of its vapour is not more than equal to about 1-5th of an inch of mercury. But at, and above 212° , its boiling point, water, under ordinary circumstances, can exist only as a gas; and in this gaseous form, and at the temperature of 212° , water obeys precisely the same laws, and exerts the same elastic force as atmospheric air would do under similar circumstances. Hence, it will be readily understood, that the law of the elastic force of vapour below 212° , is very different from the law of that force above 212° ; as by experiment is found to be the fact.

From the preceding remarks it will appear that, all other things being the same, the tendency of water to assume the form of vapour, or the rate of its evaporation, as well as the actual quantity of water in the state of vapour in the atmosphere, will increase as the temperature increases. The exact law of this increase, in all its details, we need not state. It is sufficient for our purpose to observe, that at all temperatures below the boiling point of water, that is to say, at all common atmospheric temperatures, while the rate of the increase of temperature is *slow* and uniform, or in an *arithmetical* progression, the corresponding rate of the elastic force of vapour, by which the quantity of water as vapour is determined, increases much more *rapidly*, or nearly in a *geometrical* progression. This important fact is connected with several most interesting circumstances.

The phenomena of the *Condensation* of vapour from the atmosphere, are next to be explained. As the quantity of water in solution in the atmosphere can never be greater, though it may be less, than the quantity proper to the temperature; when vapour (or what is the same thing, when a portion of air saturated with vapour), at any given temperature, is cooled below the point of saturation; a portion of the vapour is separated in the form of fluid water, while the remainder assumes the elastic condition proper to the newly ac-

quired and diminished temperature. The forms assumed by the water so separated are various, and depend very much upon the quantity separated, and on the separation taking place in atmospheric air. When the quantity of water separated is small, the minute detached particles diffused through a large space, are suspended in the atmosphere by its buoyancy, and assume the form of what, for the sake of distinction, we shall call *Visible Vapour*, viz. mists, clouds, &c. When the quantity separated is greater, the particles collect into drops too large to be upheld by atmospheric buoyancy, and they fall to the earth in the shape of rain, hail, &c.

Of the two great processes of evaporation and condensation, it may be further remarked, that by a beautiful provision, they have a constant tendency to limit each its own operations; evaporation is increased by heat and produces cold: condensation is produced by cold and liberates heat. Moreover, in virtue of another wonderful arrangement, by evaporation, water is separated entirely from all foreign bodies, and is thus condensed in a state of absolute purity.

We now come more particularly to consider the subject of the vapour of the atmosphere. To facilitate the understanding of this, we shall, in the first place, suppose the air to be absent, and shall inquire what would be the conditions of *an atmosphere of vapour*, under the pressure and temperature existing at the surface of the earth, and at different heights above the earth's surface.

As the elastic force of vapour increases faster than the temperature of the vapour; and as the mean temperature at the Equator is, at least, 80° , and that at the Poles below 32° ; it follows, that in an atmosphere of vapour, heated similarly to that of our earth, the specific gravity of the vapour at the Equator, would greatly exceed the specific gravity of the vapour at the Poles. Vapour thus exhibits a condition directly opposite to that of air, under the same circumstances. Hence the tendencies of the currents, and of diffusion, in an atmosphere of vapour, at the surface of the earth, would be precisely the reverse of those in an atmosphere of air; the tendency of the currents would be from the Equator towards the Poles, while the tendency of diffusion would be from the Poles toward the Equator.*

We have elsewhere stated the law of the decrease of the temperature of the atmosphere, observed in ascending from the surface of the earth; the atmospheric air being supposed to be free from mois-

* We may here observe, once for all, that our former remarks on the diffusion of air of different temperatures, and our remarks now on the similar diffusion of vapour, are inferences only from the general law of diffusion; and that the diffusion of such fluids has not, at least in so far as we know, been yet the subject of experiment. We do not, therefore, think it necessary to dwell on the precise law of this diffusion. Our remarks have been chiefly made with the view of drawing the attention of philosophers toward these interesting phenomena. The diffusion of gases and of vapour, taken in conjunction with the diffusion or radiation of imponderable matters, would form a noble field to those competent for such physical inquiry.

ture. A similar law would regulate the decrease of temperature in an atmosphere of vapour; but the rate of decrease would be much more slow than in an atmosphere of perfectly dry air. Thus under the Equator, where, at the level of the sea, the mean temperature is at least 80, the temperature of an atmosphere of perfectly dry air would sink to the freezing point at a height of 15,000 feet; while the temperature of an atmosphere of vapour would at the same height, sink only to 70°. At all the parallels of lower mean temperature, onward to the lowest round the Poles, at any height above the level of the sea, similar differences would exist between the temperature of an atmosphere of perfectly dry air and the temperature of an atmosphere of vapour; these differences, of course, varying with the mean surface temperature. At the same time, throughout the whole range, from the Equator to the Poles, the specific gravity of the vapour at the level of the sea would always exceed its specific gravity at any height above. Hence, in an atmosphere of vapour, there would be no vertical currents; but there would be a strong tendency to diffusion from above downwards; while the tendency to lateral diffusion, would, at all heights, be nearly the same as at the surface, or would be quite contrary to what would hold in an atmosphere of perfectly dry air.

Having thus stated the leading properties of an atmosphere of air and of an atmosphere of vapour separately, we come to the proper subject of our inquiry; viz., *the condition of an atmosphere resulting from a mixture of air and vapour*—of such an atmosphere, indeed, as that in which we actually live.

The reader will have no difficulty in understanding the nature of a mixed atmosphere, provided he has clearly apprehended what has been above stated, regarding the simple atmospheres which are its components, and will advert to two other circumstances that are now to be noticed. These two circumstances are intimately connected with the principles previously stated, and with each other; and an exposition of them is absolutely necessary for obtaining a true knowledge of the relations of an atmosphere of vapour with an atmosphere of air. These circumstances have not been mentioned sooner, the consideration of them having been intentionally delayed, in order that their influence might be seen, where their application is more immediately requisite. They are as follow.

When vapour and air are mixed together, the resulting volume of the mixture depends on the *amount of the elastic forces* of the vapour and of the air; not on any relation between their volumes. Thus when a cubic foot of air at the temperature of 32°, and exerting an elastic force equal to 30 inches of mercury, is mixed with a cubit foot of vapour, having the same temperature, and exerting an elastic force equal to only 1-5th of an inch of mercury; the volume of the mixture resulting is not two cubit feet, but only 1.0066 foot. Hence, as the addition of vapour to air adds comparatively little to

the bulk of the air, and consequently diminishes only in a trifling degree its specific gravity; the great aerial currents formerly described as pervading the atmosphere, are scarcely affected by the vapour they contain.

When two portions of vapour, having different temperatures, are mingled together; or when a portion of vapour is brought into a state of mixture or contact, with a portion of water, or with any other body colder than the vapour; *the resulting mean temperature*, whatever that may be, is, in both cases, the temperature which regulates the elastic force of the mixture. Now, since the elastic force of vapour increases most rapidly from the temperature of 32° to 212° , the increase being in a geometrical progression, while the increase of the temperature is in an arithmetical progression; it follows, that when two portions of vapour of equal bulk but of different temperatures, are mixed together; or when a portion of vapour is brought into contact with any solid colder body; the resulting mean temperature is always below that requisite to preserve the water in a state of vapour. Hence, such mixture or contact is always followed by a portion of the vapour being condensed into water. In a future part of this section, it will be necessary to illustrate further this important fact, but a familiar instance may be noticed here. Let us suppose that a pound of water at the temperature of 212° , which being in a state of steam, would occupy a space of about 27 cubit feet, were suddenly brought into mixture with a pound of water at the temperature of 32° : the effect would be an instantaneous condensation of the greater part of the steam into water. For the resulting mean temperature would obviously be far short of 212° , below which temperature the elastic force of vapour most rapidly diminishes. On this property of vapour depends the working of the common steam-engine.

The reader is thus at length prepared to enter on the complicated subject of a mixed atmosphere of vapour and of air.

We have shown that the rate of decrease of the temperature of an atmosphere of vapour, in ascending from the earth's surface, would be very much slower than that of an atmosphere of air. Now since, at all temperatures, the existence of atmospheric air is permanent; while the very existence of vapour is dependent on temperature; it follows, that in a mixed atmosphere of vapour and of air, the quantity of vapour contained in the mixture is regulated solely by the temperature of the air: that is to say, the quantity of vapour present in an aerial atmosphere, can never exceed, though it may be less than, the quantity which is proper to the temperature of the air. If the quantity of vapour in such a mixed atmosphere, be precisely the quantity that is proper to the temperature of the air, such an atmosphere is said to be *saturated* with vapour.

But, neither at the earth's surface, nor at any height above it, can the degree of saturation of a mixed atmosphere of air and vapour,

be quite equal to that which is proper to the temperature of the air ; and the difference between these two degrees of saturation, augments from above downwards. The cause of this difference may be thus explained. The rate of increase of the temperature of air, from above downward, being in arithmetical progression, and the air being, in a mixed atmosphere, that ingredient which controls the whole mixture ; the rate of increase of the tension of the vapour, instead of following the geometrical rate which belongs to it as vapour, is obliged to conform to the arithmetical rate of increase of the temperature of the air. The result of this controlment necessarily is, that the quantity of vapour present in a mixed atmosphere will, at any successive diminution of the height above the surface of the earth, become successively less and less than that which would be required to saturate the air. An example will make this result evident.

At the Equator, as we have said, the temperature of the air, at the height of about 15,000 feet above the level of the sea, is nearly 32° . Now, for the sake of illustration, let us suppose this air to be saturated with vapour. From Dr. Dalton's table of the tension or elastic forces of vapour at different temperatures, it appears that the tension of vapour at 32° is equal to the weight of .200 inch of mercury ; and that the difference between the tension of vapour at 32° and the tension of vapour at 33° , that is to say, the value of the first term or unit, in our assumed arithmetical series is .007 inch of mercury. Now, the difference between 32° and 80° the mean temperature at the level of the sea under the Equator, is 48° ; and supposing each of these 48 degrees to increase in an arithmetical progression, .007 for each degree, the tension for the whole 48 degrees will amount to .336, which added to .200, the tension at 32° gives the tension of .536 inch, as that corresponding to the vapour at 80° , the temperature of the earth's surface under the Equator. But, by Dr. Dalton's same table of tensions, we find that .536 does not represent the proper tension of vapour at 80° , but of vapour at about 61° only. According to this estimate it follows, that at the Equator, while the temperature of the air over the earth's surface is 80° , the point of saturation with vapour is 19° below that temperature. Hence, at the Equator, the air immediately incumbent on the earth's surface must be comparatively very dry. Moreover the cause which has been thus shown to produce the dryness of the Equatorial air, at the earth's surface, must all over the globe exert different degrees of the same influence. *The air, everywhere incumbent on the earth's surface, must, therefore, always be under the point of saturation ;—the relative degree of dryness being highest under the Equator, and gradually diminishing as we recede north or south towards the Poles.**

* The mathematical reader will observe, that the quantities given in the text are not rigidly accurate, but are intended only for familiar illustration of the principles

In such a mixed atmosphere as we have supposed, and as in reality surrounds our globe, if its equilibrium be undisturbed, and if it be at rest; the vapour it contains will have nearly the same tendencies to motion and to diffusion that would exist in such an atmosphere of pure vapour, as we have formerly described. But from the more equal distribution of vapour, when mingled with air, the contrasts between the specific gravities of different portions of vapour, in different parts of the atmosphere, will be much less striking than if the atmosphere consisted of vapour alone. Consequently, the rates of motion and of diffusion, which depend upon such differences of specific gravity, will be less remarkable in a mixed atmosphere, even though saturated with vapour, than they would be in a purely aqueous atmosphere; while in an unsaturated atmosphere the motions of the vapour must be still more liable to be influenced by the motions of the air, than they would be in an atmosphere of air, at its utmost point of saturation.

Before we close this part of our subject let us reflect for a moment upon the consequences of such a state of comparative dryness of the lower atmosphere next the earth. Over the greater portion of the earth, the air which, during the day at least, is warmed by contact with the earth's surface, and thus becomes lighter, has, as we have observed, a constant tendency to rise into the higher atmosphere. Now, if this air were saturated with vapour, of course, whenever the air by rising became mixed with colder air, its vapour would be more or less condensed, and a cloud would be formed. Hence, if we lived in such an atmosphere, we should be always enveloped in a mist, through which the sun would not be visible. But, by the benevolent arrangement we enjoy, this consequence is so entirely prevented, that, unless under peculiar circumstances, and always for beneficial purposes, the air at the earth's surface is hardly ever saturated with moisture. The air that has been warmed by contact with the earth can, therefore, rise from the surface, without any condensation of its nature within the limits of its point of saturation. Thus, at the Equator, before the air reaches the temperature of 61° , the presumed point of its saturation, it must ascend to the height of 6000 or 7000 feet. At this height its vapour will be condensed, and a cloud will be formed; which may either be precipitated on the spot from which its constituent vapour had risen, or may be transported by the currents of the atmosphere, similarly to refresh a distant country, or may be again dissolved in the air; while under all these contingencies the whole of the lower part of the atmosphere is exempt from mist, and continues perfectly

regulating moisture. The truth is, as has been noticed in the text, in *no part* of a vertical column of a mixed atmosphere, in a condition of equilibrium and at rest, can the air be in a state of saturation. It has been remarked, that the degree of saturation often continues nearly uniform up to a certain point, and then suddenly decreases.

transparent. These operations are unceasingly carried on in our atmosphere, over the whole surface of the earth. Moreover, the very clouds, by giving out their latent heat, and shielding the earth's surface from the direct influence of the sun, produce a still further effect, and have a constant tendency to modify their own formation and existence.

The general result of all the complicated and beautiful machinery connected with the movement of vapour is, that water is incessantly raised into the higher parts of the atmosphere, where it is again condensed in the form of rain, &c. over the whole earth. We have, therefore, in the next place to examine a little more in detail the relations of these two great processes of evaporation and condensation, as they are exhibited in nature.

Of the general Relations of Evaporation and Condensation.—The first point in the inquiry that naturally claims our attention, are the *mechanical motions by which the relations between evaporation and condensation are maintained.*

The motions of vapour, in a mixed atmosphere of vapour and air, may be considered as of three kinds: those motions arising from *convection*, in which the vapour is carried along by the air; those motions arising from the tendency of the vapour to recover its dynamical (and thermal) equilibrium, when that equilibrium has been disturbed, and which motions we shall, for distinction, term the *proper motions* of the vapour; and those motions of vapour which are caused by *diffusion*.

In a mixed atmosphere of vapour and air, the motions of the vapour, on the large scale of the operations of nature, are influenced, no doubt, in a very great degree, by the motions of the air. For example, large masses, more or less saturated with vapour, in proportion to their respective temperatures, and having either vertical or lateral motion, must carry with them the vapour they contain, whether there be much or little vapour so contained. On the other hand, motions of the air, on a smaller scale, as we shall presently see, may be even caused—may certainly be accelerated or retarded, according as the proper motion of the vapour, to be next considered, may agree with, or may be opposed to, these motions of the air. When once, however, the vapour in the atmosphere has been separated, and has assumed the form of *visible* vapour, its own proper powers of motion cease, and it becomes entirely subject to those of convection. Visible vapours, therefore, of all kinds, from their being liable to be wafted by every breeze, are in a constant state of motion, and are thus frequently carried where vapour, in virtue of its own tendency to motion, would never reach.

In an atmosphere of vapour, when the temperature, and consequently the elasticity, of any portion is reduced; the surrounding vapour, by virtue of its greater elastic force, continues to advance towards the cooler locality and to be there condensed until the ther-

mal equilibrium is restored. The motion thus arising, which depends upon its dynamical properties, constitutes what we have denominated the *proper motion* of vapour. In an atmosphere of vapour this restoration of the dynamical equilibrium, upon which the thermal equilibrium also depends, would take place with so great rapidity, as to be almost instantaneous. But in a mixed atmosphere, the case is different. In such an atmosphere, the presence of the heavier and more abundant air modifies, in a remarkable degree, the rapid motion of the lighter and less abundant vapour. Hence, instead of a rush of vapour and a momentary deluge, the motions of the vapour take place slowly; and sudden evaporation and condensation, with their consequences, are effectually prevented.

These tendencies to motion, in vapour of different temperatures, have, no doubt, great influence on the contiguous surfaces of large masses of air differently saturated; and, in particular, are liable to affect smaller masses of air differently saturated, when they are in the immediate neighbourhood of each other. Thus, as we have already noticed, the disturbance of the equilibrium of the vapour may be to such an extent, in some portion of the mixed atmosphere; that the surrounding vapour, urged to move by its tendency to restore the equilibrium, may occasionally be supposed to drag with it the air and the clouds, and thus produce local currents. For instance, let us imagine a mass of warm and almost perfectly dry air to be brought into the neighbourhood of another mass of air, of precisely the same temperature, but saturated with vapour. The two masses of air, from being of the same temperature, would, as air, have no tendency to intermingle. But as being portions of a mixed atmosphere of vapour and air, the dryer air would be, as it were, a vacuum, towards which the vapour from the moist air would have a tendency to flow till both masses of air became equally moist. In such a case, the motion of the vapour might be supposed to cause more or less of motion in the air, while a momentary cloud would probably be formed; which cloud would be dissipated when the equilibrium was restored. In this way, it is likely that many of the minor motions of the atmosphere are produced.*

The motions of vapour arising from its *diffusive* powers are quite distinct from those motions of vapour which are controlled by the motions of the air, or by the dynamical tendencies of the vapour itself to recover its condition of thermal equilibrium. These diffusive motions of vapour, as formerly observed, depend on differences between the specific gravities (the absolute quantities of matter) of contiguous and communicating gases, under the same circumstances of pressure and temperature. Though the motions of vapour depending on diffusion may retard, or be retarded by, the other mo-

* In all the cases given in the text, the effect of electricity is, for the sake of distinctness, kept out of view.

tions to which vapour is liable; in general, there is reason to believe that the motions of vapour by diffusion, in their most decided form, surpass or take place independently of, all the other motions of vapour, and in this freedom from control, resemble the radiation of imponderable bodies. The laws which diffusion obey have been already stated, and need not be again repeated. These laws may be applied to the consideration of the diffusion of vapour in the following manner.

The diffusive tendencies of an atmosphere of perfectly dry air, and of an atmosphere of vapour, would, as we have seen, at the earth's surface be in opposite directions; the diffusive tendency in the aerial atmosphere being from the Equator toward the Poles, and that in the aqueous atmosphere being from the Poles towards the Equator. The vertical tendencies also of the two atmospheres would be very different. An atmosphere of perfectly dry air, in a state of thermal and dynamical equilibrium, would have no tendency to diffusion; for the colder air in descending, and the warmer air in ascending, by change of bulk, acquire the temperature appropriate to the height. The effect of this change of bulk and acquisition of temperature is, as we have elsewhere stated, such, that if air from any height in the atmosphere were brought to the surface of the earth, it would have precisely the same temperature as the air already incumbent on the surface. But the case is different with vapour, even in the comparatively rare state in which it exists in a mixed atmosphere. We have seen that in an atmosphere of vapour, if the temperature at the surface of the earth were 80° , the temperature at the height of 15,000 feet would be only 70° ; while in an atmosphere of perfectly dry air, having a similar surface temperature of 80° , the temperature, at the same height of 15,000 from the surface, would be 32° . Now, as in a mixed atmosphere of vapour and air, the temperature of the air determines that of the vapour; if in such a mixed atmosphere, vapour having the temperature of 32° , were brought from the height of 15,000 feet to the surface, where the temperature is 80° ; the temperature of the vapour would, by increased pressure and the consequent evolution of more latent heat, be increased only to about 42° ; while, as we have seen, where the temperature of the surface is 80° , the point of saturation of the air with vapour is at least 61° . Hence the specific gravity of vapour from the height of 15,000 feet, when reduced to the same degree of pressure as that at the surface, is found to be much below the specific gravity of that vapour which actually exists at the surface. Consequently, throughout a mixed atmosphere of vapour and air, there is a tendency to vertical diffusion, the predominant tendency being from above downwards. From the extreme tenuity of vapour in the higher regions of the atmosphere, and the great tendency thereof, which that vapour has to diffusion, it is probable that the diffusive motion of the vapour may occasionally have a velocity

approaching, as we have said, to that of radiant matter, itself. In this way the rare and cold molecules of water may be supposed to dart, or radiate, as it were, far into the warmer atmosphere before their velocity is arrested. Nay, in the Polar latitudes, the molecules of water, from the higher parts of the atmosphere, may even reach the earth's surface, by shooting, like rays of heat and light, directly through the air, without materially affecting its temperature.

After these general remarks on the motions of vapour, we shall now take a rapid view of the mutual relations of the two great processes of evaporation and condensation.

We have already described the general phenomena of evaporation and condensation, and have stated the laws on which these phenomena depend. It will, therefore, in this place, be sufficient to remind the reader that the degree, and the rate, of evaporation though they increase with the temperature, are regulated chiefly by the existing degree of saturation of the air. That is to say, under all temperatures evaporation decreases, as the air that receives the vapour, approaches its point of saturation. Hence it follows, that in an atmosphere perfectly saturated with moisture, and in a state of thermal and dynamical equilibrium, there can be neither evaporation nor condensation. The processes of evaporation and condensation, therefore, always indicate a disturbance of the thermal equilibrium in some part of the atmosphere: condensation denoting a depression of the temperature below the mean, or point of thermal equilibrium: evaporation, on the contrary, denoting that the temperature in some part of the atmosphere has been raised above the mean; or at least that the temperature having been depressed below the mean, is again undergoing an elevation to the mean point. Evaporation and condensation may be thus considered as mutually dependent; so that one process cannot take place without the other. For this reason, in the great expanse of nature, these two processes oscillate or fluctuate about the point of equilibrium, within certain limits which are never passed; and which limits, though subject to countless anomalies, in general, decrease from the Equator toward the Poles.

With respect to the temperature which constitutes the point of equilibrium; in an atmosphere of vapour, that point would, of course, be the maximum point of saturation. But in a mixed atmosphere of vapour and air like that of our globe, the point of equilibrium cannot be the point of utmost saturation, but must be that *inferior point of saturation* formerly described, as being determined by the temperature of the predominant air. Thus at the Equator, where the mean temperature at the level of the sea is about 80° , the mean point of saturation will, according to our former estimate, be 61° ; while in London, where the mean annual temperature is about $49\frac{1}{2}^{\circ}$, the mean point of saturation, (or the *dew point*, as it is termed,) has been fixed by Mr. Daniell at $44\frac{1}{2}^{\circ}$. In temperate climates, the mean point

of saturation at any particular place, varies with the seasons from day to day, being higher in summer than in winter. During any shorter period, as that of a day and night, the mean point of saturation, as might be expected, generally bears a certain relation to the *lowest* degree to which the temperature has fallen during the period; since the *Hygrometer** shows that the degree of saturation, at any hour, is seldom below the point of saturation corresponding to the lowest temperature of the twenty-four hours; at which point it continues nearly uniform, so that the point of saturation during the warmer parts of the day generally varies only a few degrees. The elevation and depression of the dew point in temperate climates is thus another, and unceasing cause of change, and produces a variety in evaporation and condensation so great as to baffle any attempt at accurate inquiry.

From what has been said, it will appear that in a mixed atmosphere, the rate of evaporation and of condensation, other things being equal, will depend, not on the difference of the temperature of the air from the maximum point of saturation, but on the difference of the temperature of the air from that of the *mean dew point*; that is to say, will increase or diminish as this difference increases.

The *accidental* circumstances which principally operate to affect the rate of evaporation, are the greater or less extent of the evaporating surface, and the velocity and degree of saturation of the current of air over that surface. But besides these causes of variation, there are other circumstances which probably have great influence on evaporation; some of which are to us of the utmost interest, as being brought more immediately in contact, as it were, with our existence. The chief of these additional circumstances affecting evaporation which we shall notice, are, *Diffusion*;—*Circumstances incidental to the Water* which undergoes evaporation; and *Circumstances incidental to the Air* into which the water is evaporated.

By the general arrangement which we formerly considered, it appears that evaporation and condensation diminish from the Equator, onward to the Poles. But since increased temperature, which is the cause of evaporation, predominates at the Equator; while diminished temperature, which is the cause of condensation, predominates at the Poles; it may perhaps be inferred, that generally speaking, evaporation will be relatively greater at the Equator; and, on the other hand, that condensation will be relatively greater at the Poles. In an atmosphere of vapour such unequal effects could not indeed take place; from the rapid nature of the motions which would arise throughout the whole of such an atmosphere, so as instantaneously

* The Hygrometer is an instrument for measuring the degree of moisture of the atmosphere. That of Mr. Daniell is here alluded to, which is the only one that acts upon scientific principles. *Daniell's hygrometer* shows the degree of temperature at which water is deposited from the atmosphere, and consequently its state of saturation.

to restore the equilibrium. But in a mixed atmosphere of vapour and air, the result would be different. If there were an excess of condensation at the Poles; before the corresponding evaporation could take place at the Equator, innumerable changes would be produced in the atmosphere over all the other parts of the globe intervening between the Equator and the Poles. Further, we shall see presently that much more water is at all times condensed on the land, than is ever evaporated from the land. The excess that is condensed flows off in rivers in warm and temperate climates, and thus accumulation is prevented; but in the Polar regions this outlet is cut off, and the superfluous water would be locked up in the shape of ice. From these circumstances, therefore, and from others that might be noticed, it is not unreasonable to suppose, that in the colder climates, other things being alike, and the arrangements which regulate vapour being alone considered, condensation of water would proceed much more rapidly than its evaporation; and hence that around the Poles there would be a constant accumulation of water in the condition of ice. But we know that there is not any such accumulation, in those parts of the Polar regions which have been explored. It is manifest, therefore, that in these regions the energy of evaporation must be fully equal to that of condensation. It is indeed true, that evaporation goes on very rapidly from snow and ice. Thus Howard mentions an instance in the month of January, in a certain year, when the vapour, from a circular area of snow five inches in diameter, amounted to 150 grains between sunset and sunrise; and before the next evening, 50 grains more were added to the amount, the gauge having been exposed to a smart breeze on the housetop. Under like circumstances an acre of snow would, in the course of twenty-four hours, evaporate the enormous quantity of 64,000,000 grains of moisture! Even by the evaporation during the night only, a thousand gallons of water would, in that short time, be raised from an acre of snow. It may thus be easily understood how a moderate fall of snow may entirely vanish during a succeeding northerly gale, without the slightest perceptible liquefaction on the surface.*

We have given this statement to satisfy the general reader of the fact, that evaporation is constantly going on from snow and ice. But the quantity, great as it appears, does not surpass, or even equal, what it might be supposed to be, on admitted principles. Whether, therefore, evaporation really takes place in a relatively greater degree in the Polar regions, so as to compensate for that portion of the condensed water which is there fixed as ice, but which in warmer climates flows off to the sea, in the form of rivers, remains to be proved; though, to preserve the equilibrium and to prevent accumulations, some such supposition appears to be necessary. Can the

* Article Meteorology in the Encyclopedia Metropolitana.

difficulty be solved by the aid of the principles of *diffusion*? Does not a portion of the attenuated vapour of the Polar latitudes diffuse itself, and penetrate from thence towards the Equator; thus leaving the higher regions of the atmosphere in the Polar latitudes comparatively dry, and the lower portion of the atmosphere more apt for evaporation? And is not this diffusion of moisture from the Poles one of those beautiful expedients, which compensate for the inequalities of evaporation and condensation, and by which these inequalities are obviated?

The circumstances *incidental to water*, and affecting evaporation and saturation, arise chiefly from its purity or impurity. The presence of foreign bodies, as of saline matters, for instance, is well known to raise considerably the boiling point of water; in other words, they lower its tendency to become vapour, and thus diminish its evaporating and saturating powers. Hence the air over the sea, though, of course, much nearer, in general, to the point of saturation appropriate to the latitude and temperature, than air over the land, is comparatively seldom in a state of perfect saturation; and sea-water, so far from being capable of saturating the air with moisture, up to the dew point, has even the power of abstracting a portion of the moisture from an atmosphere so saturated, and of thus, to a certain extent, drying the air.

Evaporation on land is precisely similar to evaporation from sea-water, since the various rocks and soils may be considered as so many saline matters, diminishing, in their several degrees, the tendency to become vapour possessed by the water united with them. Hence, under like circumstances, some rocks and soils are dry, while others are moist; so that, in proportion to the evaporating powers of the rocks and soil of a country, will that country be liable to all the consequences of dryness or of dampness of soil. Plants also seem to differ much in their capacity for retaining water. The dryness of a country will, therefore, be considerably affected by the nature of its vegetation; and the predominance of certain plants or trees in a district may thus increase the dampness of its soil.

Regarding the effect that *foreign matters in the atmosphere* have in influencing evaporation from the subjacent land or water, we are unable to speak with as much confidence, as we have spoken of the controlling power of the foreign matters in the water itself. Many years ago, particular circumstances led us to form the opinion, that a combination of water and oxygen is a frequent, if not a constant, ingredient in the atmosphere. This ingredient, which we suppose to be a vapour, and analogous to (we do not say identical with) the deutoxide of hydrogen, may be the cause of numerous atmospheric phenomena, which at present are very little understood. Among such phenomena are those of evaporation we are now considering.

The difficulties attending an investigation of the atmosphere, and more than all, the total want of opportunity, have rendered us una-

ble satisfactorily to verify the opinion we have advanced. We have stated the opinion as conjectural only, and in order that the attention of those more fortunately situated may be drawn to so important an inquiry.

When treating of the composition of atmospheric air, we observed that the best analyses almost invariably indicated a slight excess of oxygen above the amount of 20 per cent., which there ought to be in the atmosphere, if its composition were, as there can be little doubt that it is, determined by the laws of chemical proportions. Now this excess of oxygen in the atmosphere, we have every reason to think, becomes periodically associated in some way with the vapour that is also in the atmosphere; and thus not only modifies the properties of the vapour, but at the same time materially influences the rate of evaporation from the earth's surface. This excess of oxygen may operate in the following manner. The vapour in union with oxygen (deutoxide of hydrogen?) ceases, of course, to act as vapour; hence in air saturated with vapour, and as moist as possible, if a portion of the vapour were suddenly to combine with oxygen, the air would as suddenly *appear* to become dry, though in reality it contained the same quantity of water in solution as before. Moreover the rate of evaporation would be increased by such a combination of vapour and oxygen; for its effects, whatever these might be, would be superadded to the ordinary effects of evaporation, and would thus more or less increase the quantity of water converted into vapour.

Oxygen in this state of combination with vapour seems to be particularly grateful, if not necessary to animal life. The air in which it abounds is dry, bracing, and exhilarating, while the predominance of moisture, from its occasional and sudden abstraction, induces the opposite feeling of dulness and listlessness. It is probable that some soils and situations are more favourable than others to its existence, and that places are more or less healthy according as it is present or absent.

The oxygen and vapour in this combination are so feebly associated that they appear to be separated by the slightest cause. Hence the results of every *common* analysis and examination of air are the same nearly as if such a state of combination did not exist. We may mention, however, as corroborative of our opinion, the bleaching qualities of dew and of the air itself, as also the large proportion of oxygen sometimes contained in snow water and in rain water; attention being at the same time directed to the well known bleaching qualities of the deutoxide of hydrogen.

Much more might be said on this curious subject, especially regarding its relation to the *electricity* of the atmosphere. But as our observations must be in some measure speculative we shall for the present desist.

Of the actual Quantity of Water that is evaporated and condensed over the Globe.—From the principles we have stated it will

appear that the quantity of water evaporated and condensed over the globe may be supposed to vary with the mean temperature, and consequently with the latitude. But, from local or other causes, the quantity varies so much, even in the same place, in different years, that the exceptions are more numerous than the instances of the correctness of the rule.

The following table, however, shows the general truth of the supposition, and that the average quantity of rain diminishes from the Equator to the Poles. In fact, a much larger quantity of rain must fall in the Equatorial than in the Polar regions, as is sufficiently proved by the magnitude of the rivers within the Tropics; for the size of the rivers of course depends on the quantity of the rain; the rivers being the conduits along which a certain portion of the precipitated water is borne to the sea.

TABLE.

	Inches.
Uleaborg	13.5
Petersburg	16, 17.5
Paris	19.9
London	*20.7, †22.2, ‡25.2
Edinburgh	22., 24.5, §26.4
Mean of Carlsruhe, Manheim, Stuttgard, Wurtzburg, Augsburg, and Regensburg, (Schow)	25.1
Epping	27.0
Bristol	29.2
England (Dalton's mean)	31.3
Liverpool	34.1
Manchester	36.1
Rome	39.0
Lancaster	39.7
Geneva	42.6
Penzance	44.7
Kendal	53.9
Mean of twenty places in the lower valleys at the base of the Alps	58.5
Great St. Bernard	63.1
Vera Cruz	63.8
Keswick	67.5
Calcutta	81.0
Bombay	82.0
Ceylon	84.3
Adam's Peak, ditto	100.
Coast of Malabar	123.5
Leogane, St. Domingo	150.‡

In this table the names of the places to which it refers are arranged progressively, according to the amount of rain that falls in each place; and though the progression exhibits great irregularities, yet the table fully establishes the general decrease of rain with the increase of distance from the Equator.

* Dalton. † Daniell. ‡ Howard. § Adie.
 ‡ From the Encyclopædia Metropolitana. Art. Meteorology, p. 123.

Sir John Leslie has shown that if all the aqueous vapour which can at any time be held in solution by the whole atmosphere, were at once precipitated on the earth in the form of rain, it would not be more than five inches in depth: now as in the course of a year many times this quantity of rain falls from the atmosphere, its replenishment of course must depend upon evaporation; of which evaporation we may thus infer the general amount. With respect to the quantity of rain that descends annually on the entire surface of the earth, we want the means of forming an estimate, though there is no proof that this quantity is subject to any material difference. The distribution indeed, as we have seen, diminishes with the latitude, and varies according to numerous local peculiarities, to some of which we shall hereafter allude. Often also, no doubt for the wisest purposes, the same place is liable to considerable fluctuations in the annual amount of rain, or at least in the times of its precipitation; yet all these variations oscillate within certain limits, and scarcely affect the mean quantity proper to the place; thus showing that the distribution of rain obeys the same laws that regulate the more general and fixed operations of nature.

Of the whole water that is condensed upon the surface of the earth, a certain portion, of course, enters into the soil. The depth to which such water sinks is determined by the declivity of the surface, by the nature of the inferior strata, and by other circumstances; but, after a greater or less period, and range of circulation, it usually again makes its appearance in the open day, in the form of *Springs*. The conjunction of springs and the occasional addition of a portion of rain water, which is neither immediately absorbed by the soil, nor evaporated, constitute brooks and rivulets; these again uniting in their progress from the higher and interior parts of the countries where this water has been deposited, form the larger rivers, which, after dispensing innumerable benefits to the inhabitants of the plains in their course, finally discharge their superfluous waters into the ocean. As the origin of the superfluous water which flows from the rivers to the ocean is thus, unquestionably, derived from the vapour condensed in the interior of the countries where the rivers originate, it follows, that in every country where there are rivers, *condensation must surpass evaporation*. That is to say, a large proportion of water condensed on the land, must have been evaporated not from the land, but from the neighbouring ocean.

The relative proportions of the water that is condensed, and of the water that is evaporated vary exceedingly in different countries. Such indeed is the amount and variety of the differences that it is impossible to estimate them; though it is probable than in the same country the proportions are nearly constant; or, at least, that there is a mean proportion about which the differences oscillate within trifling limits. In this country, Dr. Thomson has estimated that, taking the whole of Great Britain together, the mean fall of rain

amounts in the course of a year to 36 inches, the dew being included, (which is considered to amount to about four inches); and that the quantity of water evaporated is about 32 inches. Consequently, the excess of four inches must be supposed to go to supply the springs and rivers; and as these four inches are thus not taken up again by evaporation from the land, they must be drawn from the seas that encircle our shores.* These estimates of the water that is condensed and evaporated in Great Britain can only be viewed as rude approximations; and, even admitting them to be correct, they could scarcely be applied with any advantage to an inquiry into the actual condensation and evaporation in other countries or climates, which in all instances must be determined by observation and experiment.

Having spoken of the accidental circumstances which influence evaporation, we are now, in the last place, to treat of those *accidental circumstances which influence condensation*.

The condensation of vapour from the atmosphere, as we have already stated, differs in some degree, according to the origin of that diminished temperature by which the condensation is produced. We shall, therefore, commence with the phenomena of the precipitation of moisture depending on the *radiation* of heat from the earth's surface; the most remarkable of these phenomena are *Dew*, *Hoar Frost*, and certain forms of *Mist*.

Of Dew.—The phenomena of dew were first satisfactorily explained by the late Dr. Wells, who showed by the most decisive experiments that, apparently, they were all owing to the effects of the radiation of heat from the earth's surface into space, during the absence of the sun. The reader is referred to Dr. Well's "*Essay on Dew*" for details. It is sufficient for our present purpose to observe, that when the direct influence of the sun is removed in the evening, and the surface of the earth thus no longer continues to acquire heat; at that instant, from the ceaseless activity of heat to maintain a state of equilibrium, the surface of the earth, being the warmer body, radiates a portion of its superfluous temperature into the surrounding space; and thus the air immediately in contact with the surface becomes cooled below the point of saturation, and gives off a portion of its water in the form of dew.

We formerly stated that the radiating powers of bodies differ exceedingly according to their composition, the nature of their surface, their colour, &c. These differences, of course, produce corresponding effects on the deposition of dew; and, as beautifully demonstrated by Dr. Wells, explain its greater or less deposition under certain circumstances, or its entire absence under others. Thus, what formerly appeared so extraordinary, viz. why in the self-same

* On heat and electricity, p. 266. It is proper to observe, that this estimate differs considerably from a previous estimate of Dr. Dalton, who fixes the proportion of water as flowing off by the rivers, in England and Wales, at thirteen inches. It is probable that the truth lies somewhere between the two estimates.

state of the atmosphere, &c. one portion of the earth's surface, or one portion of herbage, should be covered with dew, while another in the immediate neighbourhood should remain dry, is no longer a mystery, but is perfectly explicable on the supposition of their different radiating powers.

The deposition of dew is always most abundant during calm and cloudless nights, and in situations freely exposed to the atmosphere. Whatever interferes in any way with the process of radiation, as might be expected, has a great effect on the deposition of dew. Hence the radiation of heat, and consequently the deposition of dew, is not only obviated by the slightest covering or shelter, as by thin matting, or even muslin; by the neighbourhood of buildings, and innumerable other impediments, near the earth's surface; but matters interposed at a great distance from the earth's surface have precisely the same effect. Thus clouds effectually prevent the radiation of heat from the earth's surface; so that cloudy nights are always warmer than those which are clear, and, in consequence, there is usually on such nights little or no deposition of dew.

From dew there is an insensible transition to *Hoar Frost*; hoar frost being in fact only frozen dew, and indicative of greater cold. We observe, therefore, that frosty nights, like simply dewy nights, are generally still and clear.

The influence of radiation in producing cold at the earth's surface would scarcely be believed by inattentive observers. Often on a calm night, the temperature of a grass plot is 10° or 15° less than that of the air a few feet above it. Hence, as Mr. Daniell has remarked, vegetables, in our climate, are during ten months of the year liable to be exposed at night to a freezing temperature, and even in July and August to a temperature only two or three degrees warmer. Yet, notwithstanding these vicissitudes, in the words of the same gentleman,—“To vegetables growing in climates for which they are originally designed by nature, there can be no doubt that the action of radiation is particularly beneficial, from the deposition of moisture which it determines upon the foliage; and it is only to tender plants, artificially trained to resist the rigours of an unnatural situation, that this extra degree of cold proves injurious.”* It may be observed also, that trees of lofty growth frequently escape being injured by frost, when plants nearer the ground are quite destroyed.

Such is the explanation of the phenomena of dew now universally admitted, of the general accuracy of which there cannot be the least doubt. But, we may ask, are *all* the phenomena of dew strictly referable to radiation? and does not a portion of the water deposited as dew arrive at the earth's surface by diffusion from the higher and colder regions of the atmosphere, as formerly suggested?

* Meteorological Essays and Observations, p. 511, second edition.

Of Mists and Fogs.—Mists are not necessarily connected with the deposition of dew, because during the deposition of dew the atmosphere often continues transparent, even to the earth's surface. At other times, however, and for reasons which, in the present state of our meteorological knowledge, cannot be satisfactorily explained, the deposition of dew is accompanied by a visible vapour or mist, more or less dense, and extending from the surface of the earth to a greater or less height in the atmosphere. When mists, from other causes, are general, and extend to considerable heights above the earth's surface they acquire the name of *fogs*. The optical properties and the buoyancy in the atmosphere of mists and fogs, would seem to indicate that they are not formed of solid particles, but of minute hollow vesicles, having the quality of mutual repulsion; the tendency to repel each other, preventing the coherence of the vesicles into drops, at least under ordinary circumstances. These vesicles have been occasionally observed of considerable magnitude. Thus Saussure, in one of his Alpine journeys, saw vesicles float slowly before him having greater diameters than peas, and whose coating seemed inconceivably thin. It is proper to mention, however, that there is diversity of opinion respecting the actual constitution of visible vapour.

That the cause of the formation of mists and of fogs, is, to a certain extent, similar to that of the formation of dew, appears by their prevalence over rivers and large masses of water, especially during the autumnal months. The radiation of heat from the land and from the water is at these seasons very different; the difference being greatest when the temperature of the water approaches 40° , its point of maximum density. The water is then of a temperature nearly uniform, both by day and by night, while the temperature of the land is, during the day, much higher than 40° and during the night, often much under that temperature. The water in most cases occupying the lowest situations; whenever, from the inequalities of the surface of the land, or from any other cause, the colder air produced by radiation over the land, is made to mix itself with the warmer air over the water, the moisture in the warmer air is condensed so as to become mist. Hence the formation of mist differs slightly from that of dew, inasmuch as there is occasionally (not always) an intermixture of air of different temperatures. The reason is thus evident of the fogs and mists so frequently seen over rivers and in valleys, or in other situations where there is a collection of water. The occurrence of these mists is usually on clear and cold nights,—oftener in autumn, and seldom or never in cloudy weather; the state of the atmosphere having exactly the same influence on them, as on the deposition of dew. There cannot be a doubt that these mists, like clouds, produce a great effect in impeding radiation, and in thus mitigating the intensity of cold. Mists are therefore of much importance in the economy of nature. Plants growing in low grounds

are by them shielded from the destroying influence of the sudden cold, that would almost certainly be produced, not only by the free radiation of heat in such situations, but by the descent of cold air from the surrounding high grounds.

The fogs that hang over great towns admit of an explanation similar to that of other aqueous fogs. The air of the town being warmer than that of the surrounding country, and being at the same time charged with moisture nearly to the point of saturation, is, in cold weather, suddenly cooled, either by the radiation of its own heat, or by the admixture of the neighbouring cold air; while the superfluous moisture is condensed as a fog.

The fogs of high latitudes, more especially the fogs of the Polar seas, are in the same manner owing to the radiation of heat. The cooling of the warmer air over the immense masses of floating ice, gives rise to an unequal distribution of temperature, and thus at certain seasons, to uninterrupted fogs. In all these instances the effect of fogs is probably beneficial in alleviating the severity of cold by checking great and sudden alternations of temperature, which would otherwise interfere much with the operations of organic life.

Fogs have been sometimes observed of a strong odour, apparently the result of an admixture of foreign bodies. In a subsequent paragraph these fogs will be fully considered.

Of Clouds.—From mists and fogs the transition to clouds is easy and natural; as clouds, in reality, are nothing more or less than masses of visible vapour, precisely similar to that composing fogs, but existing at a distance above the earth's surface. Clouds differ principally from mists and fogs in their mode of formation. Thus mists, like dew, as we have seen, are the results of the cooling of the lower strata of the atmosphere by radiation. Fogs are so far the result of radiation that they usually arise from the influence that air cooled by radiation, exerts on warmer air. While clouds probably depend altogether on *convection*, and result from the intermixture of strata of air of different temperatures, and in different states of saturation, in the higher regions of the atmosphere.

Such is the general opinion of the formation of clouds; but it must be confessed that there are considerable difficulties about the subject; and that the mere assumption of strata of different temperatures, more or less saturated with vapour, and having the proper motions supposed to depend upon such different temperatures and degrees of saturation, seems quite inadequate to account for all the phenomena connected with the formation and appearance of clouds. May not many of the phenomena of clouds depend upon the diffusion of vapour from cold and distant regions? May not other phenomena result from the more or less sudden decomposition (by electricity?) of the deutoxide of hydrogen which we conceive to exist in the atmosphere?

From the principles formerly stated when we described the phe-

nomena and properties of a mixed atmosphere of air and vapour, it appears that clouds in general must be formed at that elevation in the atmosphere in which the mean temperature of the air becomes equal to, or falls below the point of saturation of such air. This elevation which may be said to constitute the *region of clouds*, must of course be highest under the Equator—an inference supported by fact; for it has been observed that within the tropics, the clouds are most frequently higher than in the temperate zones; and in the temperate zones the clouds appear to be higher in summer than they are in winter. In the temperate zones Gay Lussac thinks that clouds, in general, are upheld at an average distance from the earth's surface of between 1500 and 2000 yards. Occasionally, however, clouds have a much greater altitude; and the *Cirrus*, a form of cloud to be presently described, has been seen far above the greatest elevation hitherto attained by man.

In some parts of the world clouds are rarely seen, while in other parts the sky is seldom cloudless. Such extremes are usually confined to extreme climates, or depend upon local causes. In the temperate zones, from the irregularity of the atmospheric currents, and from the other innumerable circumstances, calculated to disturb the equilibrium of the atmosphere, the general character of clouds varies much even under the same parallel of latitude. Hence all the infinite variety of sunshine, of cloud, and of shower, which more especially distinguish the temperate zones, and our own variable sky in particular; where they exert such constant and commanding influence upon our comfort and well-being, as to become almost interwoven with our very existence.

Though clouds are of such endless diversity of *figure* and appearance, they have been classed by Howard under three primary forms, and four modifications. The three primary forms are:

The *Cirrus*, composed of fibrous-like stripes, parallel, flexuous, or diverging, and extensible in all directions.

The *Cumulus*, heaped together in convex, or in conical masses, and increasing upwards from a horizontal base.

The *Stratus*, spreading horizontally is a continuous layer, and increasing from below.

The first of these forms, the cirrus, is confined chiefly to the higher regions of the atmosphere. The second form, the cumulus occupies a lower but still an elevated station; while the third form, the stratus, usually rests on the surface of the earth, constituting the mist already described in this chapter.

Of the four modified forms of clouds, two are intermediate, and two are composite.

The first of the intermediate forms is the *Cirro-Cumulus*, consisting of small roundish, and well-defined masses in close horizontal arrangement.

The masses that compose the second intermediate form of clouds,

the *Cirro-Stratus*, are likewise small and rounded, and are attenuated towards a part or towards the whole of their circumference. They are sometimes separate; when in groups, their arrangement is either horizontal, or slightly inclined, and the masses are either bent downwards, or are undulated.

Of the two composite forms of clouds, the first is the *Cumulo-Stratus*, made up of the *Cirro-Stratus* blended with the *Cumulus*; the *Cirro-Stratus* being either intermingled with the larger masses of the *Cumulus*, or widely enlarging the *cumulus* base.

The second composite form, and the last of the four modifications, of clouds, is the *Cumulo-Cirro-Stratus*, or *Nimbus*, the *rain-cloud*; being that cloud or system of clouds from which rain is falling. The *nimbus* is a horizontal layer of aqueous vapour, over which, clouds of the *cirrous* form are spread, while other clouds of the *cumulus* form enter it laterally and from beneath.

A little attention will enable any one to discriminate these varieties of clouds, at least when their forms are well defined. Yet, it must be acknowledged, that clouds often assume forms to which it is difficult to give a name.

With respect to the *motion* of clouds, it may be remarked that there is not perhaps a more frequent subject of optical delusion, nor anything regarding which we are more liable to be mistaken. Into such inquiry it would be quite inconsistent with the design of this treatise were we to enter minutely; but we offer the following brief illustration. Let us suppose a cloud moving from the distant horizon towards the place where we stand. Let us also suppose that the cloud during its motion retains the same size and figure, and that it proceeds along its course in a uniform horizontal line. A cloud so moving, when first seen, will appear to be in contact with the distant horizon; and will thus necessarily, from its remote position appear to be much smaller than in reality it is. During its advance towards us, the cloud will seem to rise into the sky, and to become gradually larger, till it is almost directly overhead. Continuing its progress it will then seem again to descend from the zenith, and to lessen in size as gradually as it had before increased, till at last it vanishes in the distance, opposite to where it commenced its movement. Thus the same cloud, without deviating from its motion in a straight line, and retaining throughout the same size and figure, will, by optical delusion, seem continually to vary in magnitude. The line of its motion also, instead of being straight, will appear to be a curve having its vertex directly above us, and its extremes boundless in opposite points of the horizon. We have given the most simple case that can be supposed. But clouds, as they exist in nature are unceasingly varying in shape, in magnitude, in direction, and in velocity; so that to form a just estimate of their figure and direction, or to unravel their motions, becomes absolutely impossible.

After what has been stated, it will be superfluous to dwell upon the *uses* of clouds in the economy of nature; we shall therefore briefly remind the reader of a few only of the most obvious benefits derived from clouds. The first of these that claims our attention is, that upon the large scale at least, clouds constitute a sort of intermediate state of existence between vapour and water, by which sudden depositions of water and their consequences are entirely prevented. If all the water separated from the atmosphere fell at once to the earth, in the state of water, we should be constantly liable to deluges and other inconveniences, the whole of which are obviated by the present beautiful arrangement. Again clouds are one great means by which water is transported from seas and oceans to be deposited far inland, where water otherwise would never reach. Clouds also greatly mitigate the extremes of temperature. By day they shield vegetation from the scorching influence of the solar heat, and produce all the agreeable vicissitudes of shade and sunshine: by night, the earth, wrapt in its mantle of clouds, is enabled to retain that heat which would otherwise radiate into space, and is thus protected from the opposite influence of the nocturnal cold. These benefits arising from clouds are most felt in countries without the Tropics, which are most liable to extremes of temperature. Indeed, clouds constitute one great means by which, in temperate climates, the extremes of heat and cold are regulated. Lastly, whether we contemplate them with respect to their form, their colour, their numerous modifications, or, more than all, their incessant state of change, clouds prove a source of never-failing interest, and may be classed among the most beautiful objects in nature.

Having finished the consideration of the various states of visible vapour, we are now to examine the phenomena of the precipitation of water from the atmosphere in the form of *Snow*, *Sleet*, *Rain*, and *Hail*. We shall first speak

Of Snow.—We commence with snow because it offers the most simple case of the precipitation of water from the atmosphere; snow being nothing more than the frozen visible vapour composing clouds. Hence a flake of snow examined with a high magnifier exhibits a beautiful display of minute crystals, often possessing the greatest variety of form.

When the temperature of the atmosphere, down to the earth's surface, is constantly below the freezing point, it is obvious that any moisture separated from the atmosphere must assume the solid form. If the quantity separated be small, the frozen particles of water remaining detached, float in the atmosphere in the form of crystallized spiculæ, and thus give origin to what is called the *frost-smoke*, a phenomena not unfrequently witnessed in polar latitudes. Even in temperate climates, the same thing has been supposed occasionally to take place in the higher regions of the atmosphere, and thus

to produce certain optical phenomena to which we shall hereafter refer.

The above are comparatively rare phenomena. Most generally the quantity of water separated is so large that the crystallized particles are agglutinated together into masses or *flakes*, and thus fall to the earth in the form of snow. When the quantity deposited is very great, as is often the case, there can be no doubt that the causes operating to produce such large deposition, are precisely similar to those which produce rain in warmer climates, and which will be considered in a subsequent paragraph.

Such, in a few words, are the principles upon which snow is formed, and from these the reason is at once apparent, why during the winter in temperate climates, and throughout the whole year in the polar climates, most of the water that falls to the earth assumes the form of snow.

We formerly mentioned how much we owe to the *whiteness* of snow; and we may now remark that we owe still more to its *low conducting properties*, and to its *lightness*. Thus by its low conducting properties snow shields vegetation from the rigorous cold of the higher latitudes, where everything herbaceous would be destroyed during the winter, were it not for the protecting influence of snow. Again if the water which now descends to the earth as snow, were to be precipitated in the form of solid masses of ice, vegetation would be destroyed, and the whole of the colder parts of the earth would be uninhabitable!

It has been remarked, in temperate climates more especially, that the air is usually warmer during a fall of snow, than before or after. This increase of temperature probably arises from the extrication of heat in the sensible form during the transition of the vapour from a fluid to a solid state. Snow-water has also been said to contain much oxygen, and thus to be particularly favourable to vegetation.

Sleet is snow in a half melted condition, and constitutes the intermediate state between snow and rain, to be next considered.

Of Rain.—When the temperature of the air is above 32° , the freezing point of water, the water separated from the air falls to the earth in the state of rain. Such is a general expression of the fact; but after all the attention that has been bestowed on the phenomena of rain, many difficulties attend the investigation, that have not yet been surmounted.

It cannot be doubted that rain is in some way connected with change of temperature; the perplexity attending the subject, arises, partly from the impossibility in many instances of accounting for the supposed change of temperature; but much more from the difficulty of understanding how this change of temperature operates. According to the usual opinion, the precipitation of water from the atmosphere is the effect of the mingling together of currents of warm

rain, is again enlivened by the sunshine, thus rendered still more agreeable by its contrast with the previous gloom.

In this manner the principles formerly detailed may be applied to the explanation of the phenomena of rain; and as far as the explanation goes it is perhaps quite satisfactory. It must, however, be allowed, as we have before stated, that the utmost information which we can at present bring to bear upon the subject of the general condensation of moisture from the atmosphere, and of rain in particular, leaves it involved in considerable obscurity.

The following additional particulars regarding the *effects of different localities*, and of *different circumstances in the same locality* which appear to influence the fall of rain, may interest the general reader.

It has been remarked that in the greater number of instances more rain falls in the neighbourhood of the *sea* than in the sea; a fact easily understood from the principles that have been stated. Among *mountains* also more rain falls than on plains; the excess is indeed striking. Thus in our own country, at Kendal and at Keswick, both inclosed by mountains, the annual fall of rain amounts to $67\frac{1}{2}$ and 54 inches respectively, while in many inland places the quantity of rain that falls in the course of a year hardly exceeds 25 inches. So at Paris, the annual fall of rain is only about 20 inches, but at Geneva $42\frac{1}{2}$ inches; and on the Great St. Bernard, the highest meteorological station in Europe, upwards of 63 inches of rain fall during the twelve months.

Although more rain falls in mountainous districts than in plains, it has been completely established, that more rain falls at the foot of a mountain than at its top. In general, too, a larger proportion of rain is separated from the air, near the *earth's surface*, than at any height above it; a discrepancy of which the present extent of our knowledge does not enable us to give a satisfactory explanation.

In most *Tropical countries* rain falls only at particular seasons of the year, there being scarcely any rain during the other seasons. Thus, at Bombay, the rainy months are June, July, August, September, and October, while the other months are almost without rain; but on the opposite side of India, along the Coromandel coast, the time of the occurrence of the rainy season is reversed; a fact strikingly illustrative of the effect of the intervention of the high table land that separates the two coasts, and which probably, by influencing the atmospheric currents, give rise to this singular alteration of weather.

In *temperate climates*, though the total quantity of rain that falls be much less than within the Tropics, there is no protracted dry season; and the rainy days in the year are more numerous the nearer we go to the Poles. Still in general, more rain seems to fall in temperate climates during the last six, than during the first six months of the year.

Among the circumstances which influence the quantity of rain in

the same locality, the most remarkable are *diminution of temperature*, and the *unusual prevalence of certain winds*.

With respect to *diminution of temperature* it has been observed that almost all wet seasons, or at least wet summers, in temperate climates, are unusually *cold*. Now from the principles formerly advanced it will be easily understood, how a depression of the temperature below the general standard in any locality, may give rise to a greater precipitation of moisture in that locality. The locality that has become colder than those around it, acts as a refrigeratory, and not only condenses and thus deprives of their elastic force, all the vapours that are in contact with it; but the neighbouring vapours rush towards the colder locality as towards a vacuum, either in the form of visible vapour or clouds, in which case they are carried by the winds; or as invisible vapour, in which form their movement may be determined by diffusion.

The effect of the *unusual prevalence* of certain winds in producing an increase of rain, or the reverse, is well known, and is quite intelligible on the principles we have explained. Thus in tropical climates, during the steady prevalence of the trade winds, the currents intermingle but little, the atmosphere is perfectly cloudless, and no condensation takes place. But when these great currents, following the course of the sun, begin at certain seasons of the year to shift their direction; their uniform course suffers derangement, they become intermixed, and condensations of moisture commensurate with the high temperature, are produced to an extent quite unknown in temperate climates. These condensations form the violent periodical rains of hot climates. So also in temperate climates, as for instance in our own country, winds coming from the south and from the west, are from a warmer climate, and hold much vapour in solution; while winds from the opposite points are colder, and therefore relatively drier. Hence winds from the south and from the west, are more frequently accompanied by rain, than winds from the north and from the east: though as we might expect, the precipitation of rain is most decided during the conflicts between these opposite currents, which sometimes extend over a large tract of country. The long prevalence of certain winds may thus cause the seasons to be wet in one part of the world, and dry in another; the water being as it were, distilled off from the one, in order that it may be precipitated on the other. Yet the whole amount of the rain in the two countries may perhaps differ very little from the usual average, while the two countries have the benefit of variety in the general amount of their rain; which variety may be salutary at particular periods, and may even be necessary to their well-being.

Before we end the examination of the phenomena of rain, it may be proper to advert to the generally admitted influence of the *Moon* on the weather, and especially on the fall of rain. This influence, however, can hardly in the present state of our knowledge be brought

to elucidate the phenomena of rain; so great are the disturbing effects of local and other peculiarities.

Of Hail.—The last form in which we have to consider the precipitation of water from the atmosphere, is hail. Hail may be regarded as consisting of drops of rain more or less suddenly frozen by exposure to a temperature below 32° . If the degree of cold has been very sudden and intense, which is often the case, the icy nucleus, from its being of a temperature far below the freezing point, acquires magnitude as it descends, by condensing on its surface the vapour of the lower regions of the atmosphere. Hence, even under ordinary circumstances, hail stones often become of considerable size, are nearly always more or less rounded, and when broken are seen to be composed of concentric layers.

From what has been stated it will be readily inferred that hail is not a product of extreme climates; indeed hail may be said to be peculiar to temperate climates, as it rarely ever occurs beyond the latitude of 60° . Hail is most frequent in spring and in summer, when it is often accompanied by thunder. It seldom hails in winter, and hail during the night is very uncommon. In tropical countries there is little hail in any place that is not more than 2000 feet above the level of the sea: in temperate climates, on the contrary, mountain tops are almost free from hail. Certain countries, especially some parts of France, are very liable to hail storms; and such is at times the fury of these storms that they lay waste whole districts. There are on record many instances of these calamitous visitations, which are usually accompanied by whirlwinds and by the most appalling electrical phenomena. During storms of such degree of severity, hail stones have sometimes fallen of enormous magnitude, and often of an irregular shape, as if they were the fragments of a thick sheet of ice suddenly broken: a supposition which alone will explain the formation of angular masses, many inches in size, and many pounds in weight. The production in the middle of summer of the intense cold that is thus indicated is a puzzle which philosophers have been unable to solve.

Of the Distribution of Heat and Light in their latent and decomposed Forms through the Vapour of the Atmosphere; and of the Effects of that Distribution.—The general distribution of heat and light in their latent forms through the vapour of the atmosphere, seems to follow the same laws as the distribution of sensible heat formerly explained. That is to say, the distribution of these forms of heat and light decreases from the Equator toward the Poles. The most remarkable effects of the distribution of latent heat have already been incidentally mentioned, and need not be here repeated. We shall therefore proceed to consider the particular distribution of the decomposed forms of heat and light in the vapour of the atmosphere, and the effects of this distribution.

Of the Relations of Electricity to the Vapour of the Atmosphere.— Atmospheric air, when perfectly dry and pure, is one of the most complete non-conductors of electricity that are known. Whether water in the state of vapour possesses similar non-conducting properties does not appear to be satisfactorily established. But the non-conducting powers of aqueous vapour must be very considerable, otherwise, since the atmosphere is never entirely free from vapour, electrical insulation could not take place. On the other hand, the moment that vapour assumes the form of water, it acquires the property of being a conductor of electricity. Hence a mass of visible vapour or cloud, when floating in a mixed atmosphere of air and vapour, is perfectly insulated, and is thus capable of electrical accumulation. Now the phenomena arising from the equalization of such derangements of electrical distribution, are *lightning* and *thunder*. Lightning and thunder therefore are nothing, either more or less, than the phenomena of electricity on a large scale; that is to say, a cloud and the earth, or two clouds, become surcharged with the two opposite forms of electricity, and thus represent the interior and the exterior coatings of an electrical jar similarly surcharged; the intervening and non-conducting air are represented by the interposed and non-conducting glass; while the lightning and the thunder are the sparks and the explosion caused by the union of the two electricities. If the reader bear in mind this analogy, it will enable him to understand the whole electrical phenomena of the atmosphere.

The distribution of electricity, like that of heat and light, decreases from the Equator toward the Poles. Thus, in intertropical countries alone, are the effects of this energetic agent displayed in all their power; there, thunder storms are quite terrific, and far surpass anything of which those, who have not witnessed them, can form a conception. In temperate climates the effects of atmospheric electricity are usually most severe in the summer; and their severity is greater in mountainous districts than in plains. Yet, even under these circumstances, they are much subdued, as compared with what takes place between the Tropics; while in the Polar regions electrical phenomena are still less striking.

Notwithstanding, however, that the general distribution of electricity in the atmosphere, evidently follows the general distribution of sensible heat, it is a remarkable fact, that whenever electrical phenomena are more than ordinarily vehement, they are accompanied by some unusual appearance of *cold*. Thus the alarming descents of hail formerly noticed, which occur most generally in temperate climates, have, in nearly every instance, been attendants of violent thunder storms. Snow also is almost always highly electric. These, and many other circumstances connected with the great and sudden production of cold in the higher regions of the atmosphere, during the display of electrical agency, cannot, in the present state

of our knowledge, be explained. For example, whence, in the middle of summer, arises that instantaneous developement of extreme cold, which occasionally produces the terrific hail storms above alluded to? At present the answer does not appear. Whether the principles advanced in the present volume be capable of solving the difficulty, time must determine.

With respect to the *sources* of the electricity of the atmosphere there have been many opinions. It seems now to be admitted that electrical excitement does not arise from the mere evaporation and condensation of water; but that, in order to produce such excitement, there must always be some chemical combination or separation.* Thus electrical excitement is the result of the chemical changes which often accompany the evaporation of water. During combustion also there is an ample evolution of electricity; the burning body giving out negative, the oxygen positive electricity. In like manner, the carbonic acid sent forth during vegetation is charged with negative electricity, and at the same time the oxygen, as is most likely, is charged with positive electricity. Derivation from these sources has been deemed quite sufficient to explain the very large quantities of electricity that are so often accumulated in the clouds. It is however probable that there are yet other causes, or at least *one* other cause, on which, in numerous instances, this accumulation may still more immediately depend. We allude to the combination of oxygen with the vapour of the atmosphere formerly mentioned. For reasons which we cannot here detail, our opinion is, that this combination of aqueous vapour with oxygen, more than any other cause whatever, is in some way concerned with the phenomena of atmospheric electricity.

The *Aurora borealis* is a phenomenon supposed to have some connexion with electricity, though its precise nature is involved in considerable obscurity. The phenomenon evidently indicates currents of some kind; and if the light be electrical, we can only suppose such electrical currents to take place in an imperfectly conducting medium. That is to say, if the phenomenon, as some contend, exist in the lower regions of the atmosphere, luminous electrical currents can be produced only by water in the liquid state; if the phenomenon exist in the higher regions of the atmosphere, as at present is supposed, such currents may depend upon the extreme tenuity of the atmosphere in these higher regions. Our own opinion is, that at different times, the *aurora borealis* exists at different heights in the atmosphere, and consequently may depend upon both these causes. Has the diffusion of vapour from the Polar towards the Equatorial regions of the globe any connexion with the phenomenon?

The phenomena depending upon the decomposition, refraction, and reflection of light by the vapour of the atmosphere are not less striking

* Pouillet, *Elémens de Physique expérimentale et de Météorologie*, tom. ii. p. 823.

and important than those produced by electricity. To such effects upon light by the atmospheric vapour we owe not only the cerulean tint of the sky, and all the splendid colouring of the clouds, but the beneficial morning and evening twilight, nay even the light of day itself. "Were it not," says Sir J. Herschel, "for the reflecting and scattering power of the atmosphere, no objects would be visible to us out of direct sunshine, every shadow of a passing cloud would be pitchy darkness; the stars would be visible all day, and every apartment into which the sun had not direct admission would be involved in nocturnal obscurity." Again to use the words of the same author, in speaking of twilight,—“After the sun and moon are set, the influence of the atmosphere still continues to send us a portion of their light; not indeed by direct transmission, but by reflection upon the vapours and minute solid particles which float in it, and perhaps the actual material atoms of the air itself.”* Such are the beautiful phenomena and the important results of the action of the vapour of the atmosphere upon light. It remains to mention a few others, of a similar character, produced by the same causes, but of less frequent occurrence and of less importance in the economy of nature.

The first of these minor phenomena which we shall notice is the *Mirage*, a phenomenon depending partly on the vapour of the atmosphere, and partly on the intermixture of strata of air of different temperatures and densities. The mirage is not unfrequent in level countries, when their surface is strongly heated by the sun's rays, and evaporation results from the continuance of the heat. The mirage assumes the appearance of a sheet of water, often exhibiting the reflected or inverted images of distant objects. In Egypt and in the neighbouring sandy plains, where the mirage is very common, the illusion is at times so perfect, that travellers can hardly be convinced of the non-existence of what they imagine they see.† The phenomena are quite explicable on well known optical principles.‡

Nearly allied to the mirage is the appearance termed *Fata Morgana*, which is occasionally witnessed in the Straits of Messina. There are many similar phenomena, all of them owing to the refraction of light by media of various densities.

The next class of phenomena to be noticed are those produced upon light by crystals of ice floating in the atmosphere, or by visible vapour. The angular forms of the crystals of ice, by determining the rays of light in different directions, give origin to various eccentric *halos*; which, by their united intensities, particularly where they cross one another, occasionally produce conspicuous masses of light, denominated *parhelia* and *paraselenes*, or *mock suns* and *mock moons*.

* Treatise on Astronomy, p. 33.

† See Clarke's Travels.

‡ See Wollaston, Philosophical Transactions, 1800, p. 239.

Visible vapours, consisting of water in the fluid state, likewise sometimes form *halos*; but these halos (when more than one exists) are always concentric, the sun or moon being in the centre. These two phenomena not unfrequently take place at the same time.

The last and most frequent phenomenon of the general kind which we shall notice is produced by the action of *fluid drops* of water upon light, viz. the well known phenomenon termed the *Rainbow*. The concomitants of the rainbow are familiar to every one: there must be rain along with sunshine. Under these circumstances if the spectator turns his back to the sun, he sees the coloured bow project on the opposite cloud, and displaying all the tints of the prismatic spectrum.

We are informed in the sacred narrative, that this beautiful phenomenon was chosen as a symbol to mankind of their exemption from future deluge. The sceptic may be challenged to state what pledge could have been more felicitous or more satisfactory. In order that the rainbow may appear, the clouds must be *partial*. Hence the existence of the rainbow is absolutely incompatible with *universal* deluge from above. So long, therefore, as "He doth set his bow in the clouds" so long have we full assurance that these clouds must continue to shower down good and not evil upon the earth.

3. *Of the Occasional Presence of Foreign Bodies in the Atmosphere and of their Effects.*—The foreign bodies that occasionally exist in the atmosphere may be considered as of two kinds; viz. *those which are merely suspended in the atmosphere in a state of mixture*; and *those which pervade the atmosphere in a state of solution*.

Both in ancient and in modern times, and in various parts of the world, rain and snow have been observed to be coloured by an admixture of extraneous matters. The nature of these colouring matters has been found to be very different in different instances: some have proved to be of vegetable origin, consisting of *minute lichens* and *other cryptogamous plants*, brought from a distance by the agency of the winds, and diffused in myriads through the atmosphere. Such vegetable matters have been sometimes more or less *red*: whence those imagined *showers of blood* we read of as producing so much popular excitation. In other instances the colour has been given by earthy and metallic matters in a state of very fine powder, and in this case their descent has been usually accompanied by violent electrical phenomena, similar to those which almost always attend the descent of *Meteoric stones* or *Aerolites*, to which perhaps they are nearly allied.

Of the falling of stones from the atmosphere, there can now be no doubt; though the origin and the nature of these stones are very obscure, and indeed cannot, in the present state of our knowledge, be explained. There have been various opinions on the subject. Some, considering aerolites to be the productions of our own planet,

have viewed them as masses projected from volcanoes to a great height and distance in the atmosphere; or as formed by the agglutination of the earthy and metallic powders from volcanoes, as before mentioned. Others ascribing to aerolites quite a different origin, have viewed them as fragments scattered through space, which happening to come within the sphere of our earth's attraction, have been determined to its surface, &c.

Although we are thus uncertain regarding the origin of aerolites, or their use in the economy of nature; it now seems by innumerable observations to be completely established, that aerolites, while in the higher regions of the atmosphere, are often in a state of intense ignition. They there assume the form of brilliant meteors, which as they approach the earth, burst with a loud explosion, followed by a shower of stones. These stones generally exhibit evident marks of fusion: and many of them have been picked up while still warm, so as to leave no doubt of their being real aerolites. It is singular too, that the composition of aerolites is in some degree peculiar. They invariably contain, either iron, or cobalt, or nickel, or all these three metals, in union with various earthy substances. Aerolites have been found of every size, from that of a few grains to the weight of several hundreds of pounds; for of this weight are some of those isolated masses of iron seen in different parts of the world, and which are generally allowed to be of meteoric origin.

Intermediate, as it were, between substances suspended, and substances dissolved, in the atmosphere, are those matters, whatever their nature may be, which have been known to spread as a haze over large districts, and have been termed "*Dry Fogs.*"

In the year 1782, and still more in the year following, a remarkable haze of this kind extended over the whole of Europe. Seen in mass this haze was of a pale blue colour. It was thickest at noon, when the sun appeared through it of a red colour. Rain did not in the least degree affect it. This haze is said to have possessed drying properties, and to have occasionally yielded a strong and peculiar odour. It is also said to have deposited in some places a viscid liquid, of an acrid taste, and of an unpleasant smell. About the same time, there were, in Calabria and Iceland, terrible earthquakes, accompanied by volcanic eruptions. These earthquakes and eruptions were supposed to have been connected with the haze. Indeed it has been generally remarked, that such a condition of the atmosphere has been usually preceded by an earthquake, either in the same or in some adjoining country. The dispersion of this haze in the summer of 1783 was attended by severe thunder storms. As might be expected, the general state of health has, for the most part, been deranged during the continuance of these phenomena. Simultaneously there have been epidemic diseases of various kinds. Thus, in the above-mentioned years, 1782 and 1783, an epidemic catarrh

or influenza, prevailed through Europe; affecting not only mankind but likewise other animals.*

The nature of the matter thus diffused through the atmosphere is quite unknown. It may be as various at different times as the character of the epidemics to which it gives origin. As an example of the extraordinary effects which foreign bodies, when diffused through the atmosphere, are capable of producing, we may mention those produced by Selenium when, in combination with hydrogen, it is diffused as a gas through the air, even in the most minute quantity. The effects of this gaseous combination of selenium with hydrogen are thus described by the celebrated chemist, Berzelius, its discoverer. "In the first experiment which I made on the inhalation of this gas, I conceive that I let up into my nostrils a bubble of gas, about the size of a small pea. It deprived me so completely of the sense of smell, that I could apply a bottle of concentrated ammonia to my nose without perceiving any odour. After five or six hours, I began to recover the sense of smell, but a severe catarrh remained for about fifteen days. On another occasion, while preparing this gas, I became sensible of a slight hepatic odour, because the vessel was not quite close; but the aperture was very small, and when I covered it with a drop of water, small bubbles were seen to issue, about the size of a pin's head. To avoid being incommoded with the gas, I put the apparatus under the chimney of the laboratory. I felt at first a sharp sensation in my nose; my eyes then became red, and other symptoms of catarrh began to appear, but only to a trifling extent. In half an hour I was seized with a dry and painful cough, which continued for a long time, and which was at last accompanied by an expectoration, having a taste entirely like that of the vapour from a boiling solution of corrosive sublimate. These symptoms were removed by the application of a blister to my chest. *The quantity of Seleniuretted Hydrogen Gas which on each of these occasions entered into my organs of respiration was much smaller than would have been required of any other inorganic substance whatever, to produce similar effects.*"†

As we have already stated, selenium, is for the most part found in association with mineral sulphur. Selenium is also, like sulphur, a volcanic product. Now, though we can hardly imagine the possibility of the diffusion of selenium through the atmosphere in combination with hydrogen; selenium may be so diffused in some other form of combination, which may produce effects analogous to those of seleniuretted hydrogen. We do not mean to assert that the diffusion of any such substance really takes place. Our intention is merely to show that a small quantity of an active ingredient, like selenium, is sufficient to contaminate the atmosphere over a wide

* See Article Influenza, in the *Encyclopædia of Practical Medicine*.

† *Annals of Philosophy*, Old Series, vol. xiv p. 101.

extent of country. Such a substance being ejected from the crater of a volcano during an eruption, or through a crevice in the earth during an earthquake, may thus produce an epidemic disease. Nor is it improbable that many epidemics, particularly those of a catarrhal kind, have so originated.

The matters occasionally diffused through the atmosphere, which appear to be *in a state of solution*, are not often perceptible by our senses, unless in some cases, perhaps, by the sense of smell.

As an instance of the presence of such bodies in the atmosphere we may mention a very remarkable observation which occurred to the writer of this treatise during the late prevalence of epidemic cholera. He had for some years been occupied in investigations regarding the atmosphere; and for more than six weeks previously to the appearance of cholera in London, had almost every day been engaged in endeavouring to determine, with the utmost possible accuracy, the weight of a given quantity of air, under precisely the same circumstances of temperature and of pressure. On a particular day, the 9th of February, 1832, the weight of the air suddenly appeared to rise above the usual standard. As the rise was at the time supposed to be the result of some accidental error, or of some derangement in the apparatus employed; in order to discover its cause, the succeeding observations were made with the most rigid scrutiny. But no error or derangement whatever could be detected. On the days immediately following, the weight of the air still continued above the standard; though not quite so high as on the 9th of February, when the change was first noticed. The air retained its augmented weight during the whole time these experiments were carried on, namely, about six weeks longer. The increase of the weight of the air observed in these experiments was small; but still decided, and real. The method of conducting the experiment was such as not to allow of an error, at least to an amount so great as the additional weight, without the cause of that error having become apparent. There seems, therefore, to be only one mode of rationally explaining this increased weight of the air at London in February, 1832; which is, by admitting the diffusion of some gaseous body through the air of this city, considerably heavier than the air it displaced. About the 9th of February the wind in London, which had previously been west, veered round to the east, and remained pretty steadily in that quarter till the end of the month. Now, precisely on the change of the wind the first cases of epidemic cholera were reported in London; and from that time the disease continued to spread. That the epidemic cholera was the effect of the peculiar condition of the atmosphere, is more perhaps than can be safely maintained; but reasons, which have been advanced elsewhere, lead the writer of this treatise to believe that the virulent disease, termed cholera, was owing to the same matter that produced the additional weight of the air. The statement of these reasons would be quite

out of place: it is enough to say, that they are principally founded on remarkable changes in certain secretions of the human body, which, during the prevalence of the epidemic, were observed to be almost universal; and that analogous changes have been observed in the same secretions of those, who have been much exposed to what has been termed *Malaria*. The foreign body, therefore, that was diffused through the atmosphere of London, in February, 1832, was probably a variety of malaria, a subject which we now proceed to consider.

In districts partially covered with water, and having a luxuriant vegetation, such as marshes and fens, particularly in warm countries; or in colder countries, at seasons of the year when the sun is most powerful; noxious exhalations arise, whose nature differs perhaps in some degree according to the locality. Such exhalations have received the general name of *Malaria*, and are well known to be the fertile source of various diseases, more or less, of the intermittent febrile type. In cold and in temperate climates, these diseases for the most part assume the character of regular ague, or of rheumatism: but on approaching to, and within the Tropics, they appear as the more formidable remittent and continued fevers, the well-known scourges of hot climates.

With respect to the nature of these exhalations our knowledge is very imperfect. Evidently, they are in some way connected with vegetation; not however with vegetation living and in a state of growth, but with vegetation in a state of decay. It has therefore been thought likely that these exhalations contain some gaseous body, composed chiefly of hydrogen and carbon. Their effect may arise from a gaseous compound of this description, though no such compound is at present known; and the probability is, that malaria occasionally owes its properties to other elements, besides the hydrogen and carbon disengaged from decaying vegetables.

We have thus endeavoured to give a concise statement of that wonderful assemblage of Laws, of Adaptations, and of Arrangements, which viewed together constitute what we term *Climate*; and which, as affecting the welfare of the denizens of this globe, undoubtedly, are not surpassed in interest or importance by any others throughout the whole of nature. Of the innumerable suns and planets that may occupy the boundless expanse of the universe we feel not the influence; even their existence scarcely obtrudes itself upon our notice. But in the light and the heat of our own sun, and in the wind and the rain of our own atmosphere, every organized being on this earth, from Man, the Lord of its creation, down to the humblest plant that drinks the dew, is alike most intimately concerned. The subject of Meteorology, therefore, in all ages and countries, has attracted the especial attention of mankind. In ruder states of society empirical prognostics, founded on the aspects of the clouds, on the movements of animals, and on other incidental occurrences, formed

the study of those who pretended to a foreknowledge of the weather; while electrical phenomena were to them objects of superstitious awe. In modern times much of this wonder and uncertainty has been removed. The gloom or the clearness of the air, the mists and the halos of a stormy sky, the restlessness and clamour of animals, &c., are now referred simply to that overcharge of moisture, and to that unequal distribution of electricity which precede a fall of rain. Nay, the very thunderbolt has been arrested in its course, and from being no longer an object of amazement, has been divested of half its terrors.

But is this advance in knowledge calculated to lessen our veneration for the great Author of nature, or to derogate from his wisdom and his power? On the contrary, our estimate of both must be greatly increased. Of the Deity, infinite as he is, and dwelling in infinity, we finite beings can form no conception. What little therefore, we can know of Him, we know nearly altogether from His works. Consequently he who has the most studied His works, will be the best qualified—nay, will be alone qualified, to form an adequate conception of Him. Thus to measure, to weigh, to estimate, to deduce, may be considered as the noblest privileges enjoyed by man; for only by these operations is he enabled to follow the footsteps of his Maker and to trace His great designs. Instructed by these he sees and appreciates the wisdom and the power, the justice and, the benevolence that reign throughout creation: he no longer gazes on the sky with stupid wonder; nor dreads the thunderbolt as manifesting the wrath of a vengeful Deity.

The constituents of climate, even imperfectly as they can be understood by us, are seen to be adjusted and arranged in a manner so surprising, that to those who admit the existence of design, they require only to be stated and apprehended, in order to their being received as additional proofs of that great argument. Where all are great, and splendid, and good, selection is precluded; but the circumstances accompanying the distribution of Water over this globe, more perhaps than any other, arrest our notice as indicative of design. Leaving out of view the other properties of water; on what other supposition, besides that of design, can we account for all these astonishing properties on which depend its evaporation and diffusion through the atmosphere—its subsequent condensation, not at once in the form of water or of ice, but in the intermediate state of clouds—its colour and lightness when in the state of snow—its power of refracting light and of conducting electricity—in short, all the numerous, minute, and happily contrived qualities displayed by this highly elaborated fluid? These together form such a union of adaptations and arrangements, each most successfully accomplishing a particular purpose, and apparently directed to, and designed for, that purpose, that to doubt the agency of design would seem impossible. Yet there are some men's minds so warped that they

either cannot or will not be persuaded of the existence of design; but asserting the omnipotence of the laws of nature, they forget Him who framed these laws, and are reluctant to give credence to His being or to His power. To such persons Meteorology offers one or two exclusive arguments, which, at the risk of being accused of tediousness, and unnecessary repetition, we shall urge briefly in this place.

The great Author of Nature, as we have before said, has chosen to act agreeably to certain established laws, by which he is invariably guided. Some of these laws we are able more or less to comprehend, and we can refer them to more general principles. Others are beyond our comprehension: we see only their effects; and even these effects are most imperfectly revealed to us. As instances of the laws of nature which it is in our power to refer to general principles, may be mentioned the currents in the ocean and in the atmosphere, by which the equilibrium of temperature over the globe is maintained. These currents, we know, are strictly referable to hydrostatic and pneumatic principles. The argument of design, which is deducible from these principles, rests, therefore, not so much on the principles themselves, as on their application precisely where they are requisite. On the other hand, as we stated at the commencement of this book, the laws of chemistry are founded solely on experience; so that our acquaintance with them is very defective; for in very few instances are they referable to the laws of quantity, and even when they can be so referred, it is only in a manner very imperfect. But though we do not comprehend the laws of chemistry, we see that many of them, perhaps all, in so far as they are intelligible to us, are entirely consistent with each other; and are as uniform in their operations as those which obviously depend on mechanical principles, or on the laws of gravity. Thus the laws, that all bodies are expanded by heat and are contracted by cold—that chemical substances do not mix, but always combine in certain proportions, and in no others,—are general laws, to which there are so few exceptions, that they are calculated on almost with as much certainty, in the operations of nature, and in the common intercourse of mankind; as the invariable and necessary results, that a heavy body will fall to the earth, or that two and two make four. We have selected these laws of chemistry partly from their general and indisputable character, and partly that the force of the argument which follows may be more conspicuous:

All bodies are expanded by heat and contracted by cold. If water had not constituted an exception to this law, though all its other properties had been the same as they now are, long before this time, as we have seen, half the water on the globe would have been converted into ice; and the existence of organized beings would have been physically impossible.

All chemical substances combine in certain proportions, and in no others. If air had been formed according to this law, everything else being the same as at present, long before this time, half of the air in the atmosphere would have been contaminated and rendered unfit for the support of animal life. In order, therefore, that *water might not be frozen*; and that *air might not become irrespirable*; *laws must be infringed*—and THEY ARE INFRINGED; infringed too, precisely where their infringement, both in kind and degree, is indispensably necessary to organic existence. Now, we appeal to the most inflexible sceptic regarding the argument of design, and ask him, on what other principle, unless that of express adaptation and design, can two such general laws have been infringed exactly in those instances in which their infringement is wanted, and nowhere else? Of the sophistry by which the evasion of this plain question may be attempted, we are quite ignorant. But we cannot resist the conviction, that one purpose of the arrangement has been that of confounding the presumptuous sceptic; who is thus perpetually reminded of the infringement of his boasted “laws of nature,” by the very water he drinks, and by the very air he breathes.

With respect to foreign bodies in the atmosphere, which have been treated of in the last section, it remains to observe, that though of very opposite characters, they have yet this resemblance; that they all apparently exist less on their own account, than as being the inevitable results of general laws established for a higher purpose. Such results of general laws may be considered as analogous to the coldness and darkness, which necessarily prevail around the poles, from the earth’s position in relation to the sun; and they have been alike permitted, not because they could not have been avoided or removed, but in the language of Paley, before quoted, “because the Deity has been pleased to prescribe limits to his own power, and to work his ends within these limits.”

Man, forgetting how insignificant he is, and how limited his utmost knowledge, is too apt to measure Omnipotence by the standard of his own narrow intellect, and to be guided by his own selfish feelings, in judging of the extent of Divine benevolence. That this earth, a minute fraction, as it is, of a great and wonderful system, should be amenable to the general laws by which the whole system is governed, is, at least, exceedingly probable. Of such general laws, of their changes, of their aberrations, or of their influences, we, situated in this extremity of the universe, cannot see the object. What therefore, appears to us anomalous or defective, may in reality be parts of some great cycle or series, too vast to be comprehended by the human mind, and only known to beings of a higher order, or to the Creator himself. So again, amidst the desolation of the hurricane, or of the thunder storm; in the settled affliction of malaria, and in the march of the pestilence; the goodness of the Deity is impugned, his power even, is regarded doubt-

fully. But what, in truth, are all these visitations but so many examples of the "unsearchable ways" of the Almighty; "He sits on the whirlwind, and directs the storm:" a hamlet is laid waste; a few individuals may perish; but the general result is good: the atmosphere is purified; and the pestilence with all its train of evils disappear. Nay, however inscrutable the object of the deadly malaria itself, do we not see one end which it serves, namely, to stimulate the reasoning powers, and the industry of man? By his reason, man has been guided to an antidote beneficently adapted for his use, which has stript malaria of half its terrors. By his industry, the marsh has been converted into fertile land, and disease has given place to salubrity.

When, therefore, we duly consider all these things; when we reflect also on the number, the properties, the various conditions of the matters composing our globe; the wonder surely is, not that a few of these matters occasionally exist as foreign bodies in the atmosphere, but that others of these matters are not at all times diffused through it, and in such quantity as to be incompatible with organic life. Thus, the original constitution of the atmosphere, and the preservation of its purity against all these contaminating influences, may be viewed as the strongest arguments we possess, in demonstration of the benevolence, the wisdom, and the omnipotence of the Deity: benevolence in having willed such a positive good; wisdom in having contrived it; and omnipotence in having created it, and in still upholding its existence.

CHAPTER VI.

OF THE ADAPTATION OF ORGANIZED BEINGS TO CLIMATE; COMPREHENDING A GENERAL SKETCH OF THE DISTRIBUTION OF PLANTS AND ANIMALS OVER THE GLOBE; AND OF THE PRESENT POSITION AND FUTURE PROSPECTS OF MAN.

In the general survey of climate, and of its reference to organization, given in the preceding chapter, we have seen, on the one hand, that, by a series of wonderful expedients, the climate or temperature of the greater portion of the earth's surface has been so equalized as to be brought within the range of organic existence. On the other hand, we shall find that, by a series of expedients, no less wonderful, organic existence has been so diversified and extended, as to include all the possible varieties of soil and climate. Hence, the arrangement, taken altogether, presents us with such extraordinary instances of mutual adaptation of its various constituents to

each other, as to admit of explanation only upon the supposition of the whole being different parts of the same magnificent Design; while the infinite variety, where all might have been otherwise, must be considered as equally indicative of the Benevolence, and the Power of the Designer.

Next to Climate, the circumstances in which organized beings are more immediately concerned is SOIL; a subject already alluded to, but which it will be necessary to illustrate a little further before we proceed.

The soil is that collection of matters, more or less in a state of comminution, which immediately covering the general surface of the earth, fills up its minor inequalities, and rounds off its asperities. On this layer of comminuted mineral substances and organic remains, all vegetables and animals, at least all land animals, depend for their existence; and, if there ever was a time when the materials composing this globe were collected into solid masses, it is evident that such a condition must have excluded organic life; even if everything else had existed the same as at present.

The formation of the soil has apparently been a work of time, and the result of the gradual attrition of the solid materials composing the crust of this globe. Hence the formation of soil has probably been always progressive, and is still going on. Besides this gradual attrition, the harder materials of our globe seem to have suffered much disintegration during those periodic convulsions formerly mentioned. By the same convulsions, also, the different comminuted materials have evidently been mixed and scattered, and finally deposited over the surface of the whole earth, so as to give occasion to that infinite variety which everywhere prevails.

The foregoing remarks naturally lead to the conclusion that the characters of the soil will generally agree with those of the rocks composing the crust of the earth; and this inference is correct. The more common ingredients in rocks are silex, alumina, lime, magnesia, and iron; and these mineral matters actually constitute the greater bulk of every soil. The remaining matters consist of more or less of various other earthy and saline principles, and of vegetable and animal remains.

After these general observations upon soils, we come to the proper subject of this chapter, which we shall consider under the three following sections:—*Of the Distribution of Plants over the globe*;—*Of the Distribution of Animals over the globe*; and,—*Of the present Condition and future Prospects of Man*.

SECTION I.

Of the Distribution of Plants over the Globe.

FROM what has been stated, it will be readily understood that Soil and Climate are the two great and immediate causes by which vegetable and animal existence are likely to be affected. We shall, therefore, in the first place, take a view,

1. *Of the differences of Vegetation, as liable to be influenced by Soil, and by other minor Local Circumstances, in the same Climate.* The most incurious observer, in travelling through a country, must be struck with the different vegetation that prevails in different parts of the country; and with the effect which this difference produces on the manners and on the health of the inhabitants. Thus, in some parts of England, the *Apple* and the *Pear* are seen growing spontaneously in every hedge-row; while, in other parts, apple and pear trees will not flourish, even with the utmost care. Some situations are favourable to the *Oak*, others to the *Beech*, others to the *Elm*. Accordingly, these well-known and beautiful trees predominate in some districts, almost to the exclusion of every other, and thus constitute the leading feature in the landscape.

These are familiar examples of partial changes among the larger vegetables of a country; while the general vegetation is supposed to remain nearly the same. Between such partial change, and the complete establishment of a peculiar vegetation, there exists among different localities, every possible shade of diversity. Many of these differences in vegetation are obviously connected with differences in soil and in situation. Thus, some plants will thrive only on a calcareous soil; as a few of the *Orchis* tribe in our own country, and the *Teucrium montanum* in Switzerland. Others, like the *Salsolas* and the *Salicornias*, will only grow in salt marshes. Some plants flourish in sea water, some in fresh; while to others again, water, at least in excess, is so prejudicial, that they can exist nowhere, unless on bare rocks, or in arid deserts. Mountainous situations are most favourable to the increase of some plants, while others abound in plains. The larger number of plants prefer sunshine, but some are most vigorous in the shade; and others are so impatient of light, that they are found only where there is absolute darkness. There are, besides, parasitic plants, like the *Mistletoe*, whose nourishment is derived from the plants to which they are attached. In short, the varieties in the nature of plants are countless, nor is the enumeration of them requisite. What has been stated is more than enough to show the wonderful arrangements that have been made, to ensure the clothing of every part of the earth's surface with vegetable organization. There is not a soil, however barren,

nor a rock, however flinty, that has not its appropriate plant; which plant has no less wonderfully found its way to the spot adapted for it, nay, will perish if removed elsewhere. Saline plants, for instance, will grow only where saline matters are abundant; plants of the marsh, and of the bog, flourish only in marshy and boggy ground; those of the parched desert and of the cloudy mountain, each in its fitting locality. Thus the soil and its occupant seem to have been made for each other; and hence one source of that astonishing variety exhibited in nature.

There are still more remarkable deviations among the plants of different countries remote from one another; even where the circumstances of climate and of soil are in every respect alike. The plants of the Cape of Good Hope, for instance, differ exceedingly from those of the south of Europe, though the climate and much of the soil be not dissimilar. Often, on the same continent, nay, on the same ridge of mountains, the plants on the opposite sides have no resemblance. "Thus, in North America, on the east side of the rocky mountains, *Azaleas*, *Rhododendrons*, *Magnolias*, *Vacciniums*, *Actæas*, and *Oaks*, from the principal features of the landscape; while on the western side of the dividing ridge, these genera almost entirely disappear, and no longer constitute a striking characteristic of the vegetation."*

In general, the plants of America are different from those of the old world, except towards the north, as it might be expected from the nearer approximation of the two continents, many individuals are common to both. The plants of islands, and those growing in isolated situations are often quite peculiar. Thus the plants of New Holland, with comparatively few exceptions, differ from those of all the rest of the world; and, "of sixty-one native species, in the little island of Saint Helena, only two or three are to be found in any other part of the globe."† These facts are quite inexplicable upon any known principles; and are calculated to excite a more than ordinary degree of attention, as being solely referable to the will of the Great Creator; who has chosen to provide infinite diversity where all might have been uniform and monotonous; and has thus rendered more conspicuous his wisdom, his power, and his goodness.

2. *Of the Influence of Climate on Vegetation.*—The climate of a place, as has been before shown, independently of minor local causes, is influenced chiefly by the two following circumstances:—the Latitude of the place; in other words, the general portion of heat and light which it receives from the sun;—and its height above the surface of the sea; by which circumstance of elevation, the heat at least received from the sun, is liable to be varied as much as by latitude;

* Lindley's Introduction to Botany, page 489.

† See Principles of Geology, by C. Lyell, vol. ii. where this interesting subject is considered in detail.

but the variation is according to other laws than those which depend on mere latitude, indeed, according to laws which vary in different latitudes.

Every one is acquainted with the general fact of the difference between the plants of warm and those of cold countries; between the plants that grow on plains, and those that grow on mountains. Thus, "in the countries lying near the Equator, the vegetation consists of dense forests of leafy *evergreen trees*, *Palms*, and *arborescent Ferns*, among which are intermingled *epiphytal herbs* and *rigid Grasses*. There are no verdant meadows, such as form the chief beauty of our northern climate, and the lower orders of vegetation, such as *Mosses*, *Fungi* and *Confervæ* are very rare. As we recede from the Equator, the plants above mentioned gradually give way to *trees* with *deciduous* leaves; rich meadows appear, abounding with *tender herbs*; the *epiphytal Orchideæ* are no longer met with, and are replaced by terrestrial fleshy-rooted species; *Mosses* clothe the trunks of aged trees; decayed vegetables are covered with parasitical *Fungi*; and the waters abound with *Confervæ*. Approaching the Poles, trees wholly disappear; *dicotyledonous* plants of all kinds become comparatively rare; and *Grasses* and *cryptogamic* plants constitute the chief features of the vegetation."*

Changes not very dissimilar are observed in the vegetation at different heights on the mountains of warm climates. Thus, at the base of the celebrated Peak of Teneriffè, the plants have all the distinguishing characters of those of Africa. There flourish the succulent *Euphorbia*, the *Mesembryanthema*, *Dracæna*, &c.: also the *Date Palm*, the *Plantain*, the *Sugar-cane*, and the *Indian-fig*. A little higher, grow the *Olive tree*, the *fruit trees* of Europe, the *Vine*, and *Wheat*. Then succeeds the woody region of the mountain; where from the numerous springs the ground is always verdant. In that region is seen a profusion of beautiful evergreens: such as various species of *Laurel*, one of *Oak*, two species of *Iron-tree*, and *Arbutus*, and several others. Next above is the region of pines, characterised by a vast forest of trees resembling the *Scottish fir*, intermixed with *Juniper*. Then follows a track remarkable for the abundance of a species of broom. At last the scenery is terminated by *Scrofularia*, *Viola*, a few *Grasses*, and *cryptogamic* plants.†

The proportions which different groups of plants bear to each other, vary exceedingly in different latitudes. An interesting table given in the Appendix, slightly altered from Humboldt, exhibits the proportional amount of some natural groups of plants to the whole mass of vegetation in the zones mentioned; and will enable the reader to understand the relation of vegetable forms to the greater or less distance of their place of growth from the Equator. The ar-

* Lindley's Introduction to Botany, page 484.

† Humboldt.

rangement is so obvious as scarcely to require explanation. Thus in the equatorial zone, between 10° north and 10° south latitude, the first group, including *Ferns*, *Lichens*, *Mosses*, and *Fungi*, constitutes on the plains only 1-15th, but on the mountains 1-5th of the whole number of plants that exist in that zone. While in the temperate zone the proportion of the first group of plants is at least one-half of the whole number, and in the frigid zone, the entire vegetation consists of plants of that group. The distribution of the other groups is equally remarkable.

From this table we learn many interesting particulars in addition to what has been already stated regarding the distribution of plants over the surface of the globe. We may notice especially the striking difference between the Flora of the Old and that of the New World, in corresponding parallels of latitude. These differences, in a great many instances, are undoubtedly referable to the unknown causes to which we have before alluded. But in other instances, they are obviously connected with the difference of temperature that prevails in the two continents under the same parallel. Before we proceed, let us dwell a little longer on the consideration of these beautiful arrangements.

In tropical countries alone, beneath a vertical sun, do we see vegetation in all its glory and magnitude. There, the form, the colour, and the odour of plants are developed to the utmost; and where else could they be so developed? where else could the majestic palm rear its towering stem, and send forth its gigantic leaves? where else could we expect to find groves ever verdant, blooming and productive? Amidst eternal summer, all is in character; forests denuded of their leaves, and for half the year assuming the appearance of death, would in such a climate be perfectly incongruous. But in countries remote from the Equator, and in which, during many months, the temperature is more or less depressed, a vegetation thus incessantly active could not exist nor would it be appropriate. Accordingly, the palm tribe, and many of the more distinguishing productions of the Tropics become gradually fewer in number as we recede from the Equator, and at last give way entirely to deciduous plants; that is, to plants endued with the power of *hibernating*, or sleeping, as it were, in the colder season; and which vegetate only during the warmer portion of the year. And here we have displayed another of those admirable provisions, which at once strike us irresistibly as being the effect of design! In Tropical countries, where the seasons are uniform, and where there is no cold to injure, the leaf buds of plants are without covering or protection, and are freely and confidently exposed to the atmosphere. But in climates where the seasons change, and where vegetation is liable to be suspended by the cold, the leaf buds exhibit a structure remarkably different. Developed in the latter end of summer, or autumn, they are almost invariably provided with *tegmenta* or coverings; within which, during

their period of torpor they are cradled, safe from cold and from accident!

As we advanced still further to the north or to the south, where the winter becomes more severe and of longer continuance, deciduous plants in their turn diminish both in number and in magnitude; and after having shown themselves under a variety of stunted forms, are at length almost entirely superseded by a few coarse grasses and lichens. Yet even here design is apparent. These hardy natives of the poles are, from the simplicity of their structure, wonderfully adapted to the climate of the region they occupy; in which alone they will flourish, and for which alone, therefore, they have been expressly created.

Though it be generally true that plants will grow only in the soil and climate adapted for them; yet, as if intentionally to evince His power, the Great Author of nature has created some manifest exceptions to this rule. All organised beings have been more or less endowed with the faculty of accommodating themselves to circumstances. In the larger number of plants this faculty scarcely exists; but in some it is much stronger; and in others, constituting the exceptions to which we allude, the extent of the accommodating faculty is almost incredible. In general, plants that are the natives of peculiar soils, and of extreme climates, are the most impatient of change; while the natives of ordinary soils, and the temperate climates, have a wider range of growth. The exceptions to the rule of adaptation are chiefly among plants that are natives of such soils and climates. Thus "the *Samolus Valerandi* is found all over the world, from the frozen north to the burning south; associated here with *Birches*, and similar northern forms, and there mixed with *Palms* and the genuine denizens of the tropics. The number of plants, however, which can thus accommodate themselves to all circumstances and climates is limited; while those which readily naturalise themselves in climates similar to their own, are, on the other hand, numerous. Of the latter, indeed, examples present themselves at every step. All the hardy plants, for instance, of our gardens may in some sort be considered of this nature; for although they do not grow spontaneously in the fields, they flourish almost without care in our gardens. The *Pine apple* has gradually extended itself eastward from America, through Africa, into the Indian Archipelago, where it is now as common as if it were a plant indigenous to the soil; and in like manner the *Spices* of the Indians have become naturalized on the coast of Africa and the West India islands." To this property of naturalizing themselves, no doubt, is to be referred, in a variety of instances, the presence of the same plants in different countries. For though, as we have just stated, the Flora of different countries is generally different, yet in almost all instances, some plants exist which are found in other countries. Thus, "above 350 species are said to be common to Europe and North America; and even among the peculiar features of the

Flora of New Holland, Mr. Brown recognised 166 European species. The presence of many such strangers may undoubtedly be referred to the agency of man and other animals; to currents in the ocean, to winds, and a variety of natural causes." While "the presence of others, seems inexplicable on any other supposition than that they have been created in the places where they now exist."*

Hitherto we have considered plants only in relation to the soil and to the climate in which they grow; and have not entered into details respecting all the beautiful arrangements, by which their growth has been accomplished. The consideration of these arrangements belongs to the Physiologist, the Botanist, and the Geologist, with whose duties we wish as little as possible, to interfere. There is, however, yet one point of view in which our argument naturally leads us to consider vegetation; namely, as forming the link, by which animals are connected with the earth; in other words, as furnishing to animals the means of subsistence.

One circumstance, which, perhaps more than any other is calculated to arrest our attention with respect to vegetable productions in general, is their vast *profusion* in every sense of the term; whether we contemplate their variety, their magnitude, or their number. Thus the numerous and varied plants growing in topical climates are equally remarkable from their size, the luxuriant foliage, and the exuberance of their roots and seeds. Let us take, for instance, the palm tribe. It has been estimated that there are a thousand species of palms; and though the number actually known to exist is by no means so large, yet late discoveries seem to render the estimate not improbable. In many of the palm tribe the developement of the form, and the quantity of flowers and fruit is altogether extraordinary. Among others, the species which yields the well known *Cocoa nuts* grows to the height of eighty feet; each plant flourishes for a century, and, during the greater part of that time, continues to produce annually at least a hundred of these large nuts. Yet the cocoa nut species may be considered as one of the least productive of the palm tribe: for every bunch of another species, the *Seje* palm of the Oronoko, bears as many as 8000 fruit; while a single spatha of the *Date* palm contains 12,000 flowers; and in a third species, the *Alfonsia Amygdalina*, there is the enormous number of 207,000 flowers on each spatha; or 600,000 on a single individual plant!

In superlative exuberance, however, the Palm tribe must yield to the *Banana*, or plantain, another inhabitant of the tropical countries. The fruit of this plant is often a foot in circumference, and seven or eight inches long: it is produced in bunches, containing usually from 160 to 180 fruit; and each bunch weighs from 66 to 88 pounds avoirdupois. As Humboldt has remarked; the small space, there-

* Lindley, Introduction to Botany, p. 501.

fore, of 1000 square feet, on which from thirty to forty Banana plants may grow, will, on a very moderate computation afford, in the course of a year, 4000 pounds weight of fruit; a produce 133 times greater than could be obtained from the same space, if covered with wheat; and 44 times greater than if occupied by potatoes. The *Orange* tree may be mentioned as another instance of extraordinary fecundity; thus a single tree at St. Michael's has been known to bear in a season 20,000 oranges fit for packing, exclusively of those damaged and wasted, amounting to at least one-third more. An example to the same effect, but of a different kind, is the *Sugar* cane, which furnishes an unlimited supply of saccharine matter in its purest form; while various roots, as those of the *Cycas* *Jatropha*, and many others abound equally in farinaceous matters.

As we withdraw from the Equator into the regions of hibernating plants, vegetation is seen on a much less magnificent scale; though in the temperate climates, and even where we might expect to find utter sterility, *number*, in some degree, compensates for *magnitude*. Thus, instead of the single stupendous tuft of the palm, we have the numerous congregated buds of our deciduous trees; instead of the gigantic and solitary grasses of the torrid zone, we have the smaller and gregarious varieties. Some of these varieties, as the *Cerealia*, or Corn tribe, with their myriads of seeds, give us an inexhaustible supply of farinaceous aliment; while others, as the Grasses properly so called, clothe our meadows with verdure, even to extreme latitudes; and are equally productive of matter purely herbaceous. In the warmer parts of the temperate zone, the Olive and the Vine afford the oleaginous and the saccharine principles under a form, different, but not less useful than the oil and the sugar of the tropics; while in colder parts, various seeds, and hardy fruits, produce an ample store of the same valuable articles, though in a condition still further modified.

In the preceding sketch we have intentionally kept out of view the existence of animals, that we might here ask the question, Of what use is all this amazing exuberance of superfluous matter throughout the globe? The adaptation of plants to the climates in which they flourish is evidently the work of an intelligent Creator. But is this apparent waste of materials and of labour to be reconciled with the same wise agency? Surely, the mere existence of vegetation did not require such prodigality. Seeds, for instance, need not have been enveloped in bulky fruits; nor need they have been produced by myriads: and all that foliage, all those flowers, and roots, in such amazing profusion, of what use are they; why were they so created? Regarding vegetation as a thing simply adapted to climate, and existing for its own sake alone, the question scarcely admits of a rational answer. But, considering at the same time the existence of animals, and viewing these superfluities as the means by which ani-

mal existence is principally upheld, every difficulty vanishes, and the splendid design of the whole wonderful scheme becomes at once apparent. We are thus brought to the consideration of animal existence.

SECTION II.

Of the Distribution of Animals over the Globe.

ANIMALS have been so constituted that food is to them indispensable: they can, therefore, exist only where their food has been supplied by nature. On land, at least in the warm and temperate climates, by far the greater proportion of animals derive their subsistence, either directly or indirectly, from the vegetable kingdom. For those animals that are themselves carnivorous, prey on vegetable feeders much oftener than otherwise; and are thus remotely dependent on vegetables. Of the habits of animals living in the sea, and thus concealed from our view, we know still less; but in general they appear to prey on each other, the stronger, as is usual, devouring the weaker.

We have seen the wonderful diversities that prevail among vegetables, in different situations and climates; and it may be truly said that the diversities among animals are not less numerous, and are even more extraordinary. Thus, in every climate and soil, almost every herb has its appropriate inhabitant; some little being, that comes into existence, passes its ephemeral life, and dies on that plant; to which, therefore, that plant constitutes the world. Nay, in general, even different parts of the same plant have each its separate occupants, one feeding on its fruit, another on its flowers, a third on its leaves, perhaps a fourth on its very woody core. This almost infinite diversity, and infinity of number, are principally confined to the smaller animals, or insects. As animals increase in size, the number of species as well as of individuals constantly diminishes. Thus, while there are hundreds of species of the Beetle tribe, and the individuals are countless, there may be considered to be only one Elephant; and while Shrimps are in numbers like sand on the sea-shore, the Whale is as much a solitary species. This striking difference with regard to numbers has been considered to arise necessarily from a law of nature, and in one respect such an explanation is very obvious; but in another point of view, we may contemplate an admirable evidence of design. It is clear that millions of elephants could not exist, if for no other reason, from want of food; but why should millions of beetles exist? why should these little creatures,—whose life is so transitory, that it consists of little more than of being born, and of dying, whose structure is so frail as to be liable to be annihilated by the slightest accident, who are everywhere surrounded by all sorts of enemies, to many of which they constitute a natural prey,—why, we ask, in spite of all these obstacles and dangers, should these insig-

nificant animals contrive to exist in the numbers we see them? No natural law, surely, will explain the appearance of such multitudes. The difficulty requires another solution; and the only solution that can be offered is *design*—that it was so designed by the Great Author of nature. And how has He effected His purpose of multiplying to such an extent these little animals? The answer is, simply, by increasing their fecundity. Had beetles, like elephants, brought forth only one young at a time, long ere now, their race would have been exterminated; but being produced by thousands, some of the numerous offspring chance to escape, and thus the race is perpetuated.

We shall not dilate further on the arrangements that have been made for the existence and preservation of animals, but shall proceed to consider their distribution.

The distribution of animals over the globe may be conveniently treated of under the same heads as the distribution of vegetables; and, first:—

1. *Of the Differences existing among Animals that live in similar Situations in different Parts of the World.*—The dwelling of animals in the waters is, perhaps, the most remarkable as regards their localities. Now, since, from circumstances formerly stated, the distribution of temperature is very different in the sea from what it is on land; and since most aquatic animals prey on each other, and consequently in some degree are independent of climate; the distribution of such animals over the globe follows laws materially different from those which regulate the distribution of land animals. This distribution of temperature more especially affects the distribution of animals in high latitudes; and must be taken into account at the very outset of this part of our inquiry. We shall, therefore, state concisely the distribution of land animals, and of sea animals, apart from each other.

The distribution of land animals resembles to a certain extent that of vegetables; for though animals differ from plants, in being endowed with the power of locomotion, yet, as the larger number of animals are dependent on vegetables for their subsistence, they are necessarily confined to those places where their peculiar food may be obtained. This limitation of range is most observable in the case of the smaller animals. The existence of many kinds of insects, especially, is intimately connected with that of certain plants. In every tribe of animals, however, there are species that occupy very different localities. Thus, in the same tribe, some species dwell on the mountains, others on the plains; some are most numerous on the sea-coast, others live on trees, while there are others that burrow beneath the surface of the ground. All these diversities, in regard to residence, are probably influenced, like many others, by the greater or less degree in which the locality affords the means of obtaining subsistence. But, in many animals, there is also a wonderful adaptation of structure to the place they inhabit; proving,

beyond a doubt, that the distribution of animals has been arranged by design; and that they form but a part of the great symmetrical whole of creation.

In animals that dwell in the water, the same peculiarities of habitude are observable, as in those that dwell on the land. Thus, it is perfectly known that many animals can live only in salt water; others only in fresh. Some prefer the deep and open sea, others are met with only in shallow water, or at the mouths of rivers. Of those that flock to the coast, some shun turbid water, others burrow in the mud. In short, though the habits and adaptations of aquatic animals can be less satisfactorily ascertained, there is every reason to believe that they are at least as wonderful, as those of the occupants of the land.

There is an equally striking diversity in the animals, as in the plants, of similar localities and climates in different parts of the world. Thus, in the old world, in the analogous climates on the north, and on the south of the equator, though many genera exist in common, yet the species are totally different. For instance, the northern hemisphere possesses the *Horse*, and the *Ass*; while, in the south, these species are represented by the *Zebra* and the *Quagga*. In the southern hemisphere, there also exist many species which are quite peculiar; as the *Giraffe*, the *Cape Buffalo*, and a variety of animals having the *Antelope* form. So, likewise, the animals of the old and those of the new world are, in general, quite distinct; unless, perhaps, towards the north, where the two continents approximate; and where, in consequence, there are some species common to both. Thus the *Elephant*, the *Rhinoceros*, the *Hippopotamus*, the *Giraffe*, the *Camel*, the *Dromedary*, the *Horse*, and the *Ass*; also the *Lion* and the *Tiger*, and various species of *Apes*, *Baboons*, and other animals, with which we are familiar in the old world, were not found in America. On the other hand, the American species, the *Lama*, and the *Peccari*; and among carnivorous animals, the *Jaguar*, or American tiger; also the *Agouti*, the *Paca*, the *Coati*, the *Sloth*, and others, were equally unknown in the old world. Again, the animals of New Holland differ, like its vegetation, not only from those of our continent, but from those of all the world besides. In New Holland, there are more than forty species of marsupial or pouched animals, of which the *Kangaroo* is that with which we have become best acquainted; while everywhere else, there is hardly a known instance of a pouched animal. Nor are these differences confined to the more perfect animals. They are even more striking as we descend in the zoological scale. Thus among birds; the individual species of the *Parrot* tribe, that are found in America, differ altogether from those of Africa; and those of Asia differ from both. The minute and beautiful family of *Humming birds* is peculiar to America. While the species of the common *Grouse* of this country is met with in no part of the known world.

From the class of reptiles, may be mentioned the Great Saurian, or Lizard tribe. Thus the *Crocodile* of the Nile is entirely different from the *Cayman* of America; and even from the *Gavial* of the Ganges. In the division of snakes, too, the *Boa* of India differs from the nearly allied *Python* of America; and of the poisonous varieties, the *Rattlesnake* is peculiar to America, the *Cerastes* to Africa, the *Hooded snake* to Asia. As we have already stated; the diversities among insects are still more numerous and remarkable than among the larger animals. To enter into details would be endless; we shall therefore mention only one of the best known and widest extended of all the insect tribe, viz. our *common Bee*. This insect did not exist in America, or in New Holland; though it is found in all parts of the old world; the wax and honey of Europe, Asia, and Africa being obtained from species having a close resemblance to each other.

Nor are these differences confined to land animals; the inhabitants of the waters are equally diversified. Thus the *Whales* of the northern ocean are quite unlike those of the south; as are the *Seals*, and other analogous animals in the polar regions. The fishes of different seas, also, not only when far apart; but even of some which freely communicate, have fish exceedingly dissimilar. Thus the fishes of the Arabian Gulf are said to differ entirely from those of the Mediterranean; notwithstanding the proximity of these seas. Nor do these remarks apply only to the larger fish in these seas, but hold equally with respect to their testaceous and molluscous species.

Such are a few of the more striking facts with regard to the distribution of animals in similar climates and localities throughout the world. We shall now briefly speak,

2. *Of the Effects of Diversity of Climate on the Distribution of Animals.* In tropical climates, the qualities of animals, as well as those of vegetables, are developed to the utmost; whence arises that harmonious adaptation of all the works of nature, conspicuous, indeed, in all climates, but in Tropical climates more especially. For, where else than amidst the profuse exuberance of the vegetation within the tropics, could the *Rhinoceros*, the *Giraffe*, and other large quadrupeds find subsistence? Where else could we expect to see such birds as the *Ostrich* and the *Cassowary*? Such reptiles as the *Crocodile*? such serpents as the *Boa*? To what other part of the world could the magnificent butterflies, the enormous beetles and spiders be so appropriate. Even among the marine animals of Tropical climates, some display the same wonderful enlargement of size. Thus certain species of the *Crab* and *Lobster*, and various shell-fish, often attain an enormous magnitude. Nor is there a developement of size only, but of every other property in an equal degree. Countries within the tropics exhibit the most beautiful forms—the most splendid colours in nature. There,

in short, is the most astonishing display of all those things which seem to be entirely ornamental: as, for example, the singular plumage of the *Birds of Paradise*—the gaudy liveries of many of the *Parrot* tribe—the extraordinary and diversified forms and colours of many insects and shells.

Not only is there in Tropical climates an assemblage of all the concomitants of productiveness, and utility, and embellishment of every kind; in these climates, there is another and not less marked demonstration of the power and the wisdom of the great Creator. Within the Tropics *death*, the last, the inevitable scene, assumes a character as new and diversified as that of the life it terminates. There, rages the implacable ferocity of the Tiger, and of the larger beasts of prey; there, are the fangs of the serpent charged with the most malignant venom; there, even the insects are as formidable as they are numerous. Nor is this intensity of the destroying power incongruous or without an object; but obviously is in perfect harmony with the rest of creation, and with the design of the Creator. The wonderful productiveness of animals in Tropical countries renders unavoidable some checks against their excessive increase: and in devising these, the great Author of Nature has displayed the same attributes that are manifest in all his other works. No one who seriously reflects can doubt either the wisdom or the benevolence of the provision. For why are Tigers and Serpents confined to those parts of the world where their existence is not only accordant, but where, for one great purpose at least, they are even necessary. Surely such limitation could have happened only from design; and the argument is strengthened a hundred fold; when we contemplate the striking display of wisdom and of power exemplified in the singular adaptation of structure in these animals, to their peculiar habits. Thus how wonderfully appropriate is that of the Tiger; and how extraordinary as well as wonderful that of Serpents! Who (unless he had witnessed the fact) could have believed that the animal frame was capable of separating from its juices, and of retaining with impunity, a poison instantly fatal, not only to other animals, but to the animal itself; if again mingled with the juices from which it had been separated!

Nor in all these things is the benevolence of the Deity less conspicuous than his wisdom. *All must die*; and death from rapacious or venomous animals is probably not in any degree more painful than many other modes of death, which we constantly witness. There is, in truth, to our own narrow and selfish feelings something exceedingly painful in the idea of being torn to pieces by a Tiger, or stung to death by a Rattlesnake; but how many thousands of little mice are destroyed by cats? and how many myriads of unfortunate flies are poisoned by spiders, every day we live? and yet we hardly commiserate them. The question, therefore, is simply a question of degree; and viewing the existence and the destruction

of animals, as they ought to be viewed, on the great scale, we find that the whole is perfectly in unison. While in temperate climates we have cats and spiders, designed as checks on over-productiveness; amidst the grandeur and the luxurious development of the Tropics, the same wise purpose is executed by the Tiger and by the Rattlesnake.

As we advance from the Equator into the temperate climates, the size of animals in general, like that of vegetables, becomes gradually smaller. Like the vegetables, too, the animals of temperate climates are more gregarious than within the Tropics. Hence *number*, as among vegetables, compensates in some degree for diminished *magnitude*. The two kingdoms of nature therefore are beautifully analogous; for the gregarious grasses, which, as we before observed, form so marked a feature in the vegetation of temperate climates, constitute in one shape or other the principal food of the gregarious tribes of animals. Thus the whole cattle tribe—The *Ox*, the *Sheep*, the *Goat*; the different varieties of *Deer*; the *Rabbit* and *Hare*; also the *Horse* and the *Ass*; with a multitude of other well-known animals, of a similar character, are natives chiefly of temperate climates, and obtain their nourishment almost entirely from the grasses. Among birds, the numerous species of the Gallinaceous, or Fowl tribe, may be said to derive their food from the same source. Therefore, as regards the existence of animals, the gramineous tribe of plants is more important than perhaps any other; and could not be annihilated, without the destruction of the present order of living beings.

As further examples of animal species indigenous to temperate climates, may be mentioned the *Canine* species and those allied to it, most of which are more or less carnivorous; also the *Hog*, and a variety of other animals that need not be here enumerated. The *Hog* tribe, as is well known, are omniverous; but in their natural state, they feed principally on the seeds and roots of plants. Among birds peculiar to temperate climates are various tribes of *Water-fowl* that subsist on fish and on insects. Of the smaller land birds, the various *Songsters* offer a remarkable contrast to those of similar form within the Tropics; not only from their more melodious notes, but from the simple colouring of their feathers. In temperate countries the *Insects* are still exceedingly multiplied; though, in general, like the other animals, they are much smaller in size than those within the Tropics; their forms, their colours, and other peculiarities also are much less remarkable.

As we advance toward the Poles, the animals of temperate climates are observed gradually to decline in number. The vegetable feeders become reduced to a few hardy species; and at length in the remote north and south scarcely any vegetable feeders remain. So far as shrubby plants continue to grow in these inhospitable regions, individuals of the *Squirrel* tribe find subsistence on their seeds

and roots. But the most remarkable herbivorous animal is the *Reindeer*; whose principal food is afforded by nature in a species of moss peculiar to very cold climates. Those that exist beyond, are either carnivorous or piscivorous. The *Arctic Fox* and the *Bear* are familiar instances, as terminating the Zoological series, viewed in connexion with the influence of climate.

We have, in the last place, to notice what is most remarkable in the distribution of *Marine* animals.

For the reasons before stated, the general temperature of the ocean differs considerably from that of the land. Owing to this difference of temperature, and to the peculiar mode of subsistence of marine animals, which find their prey chiefly in the waters they inhabit; the distribution of these animals varies much, as compared with the distribution of animals that are entirely terrestrial; particularly within the frigid zone. It is true, indeed, that in all climates, the denizens of peculiar localities, as fresh water species and those that resort to the shallows on the coast, are influenced by the climate nearly as much as land animals: and within the Tropics, this influence extends in some degree even to the species that dwell on the wide ocean. But far to the north, and to the south, such species are influenced in a manner altogether different. Thus the largest of known animals, the *Whale*, and of course those other animals that become its prey, roam through the utmost Polar seas; where on land the intensity of the cold would prevent the existence of any animal whatever. In that climate the whale is enabled to live, solely on account of the greater warmth of the Polar ocean, as has been formerly explained. Among the larger inhabitants of the ocean in Tropical climates, may be mentioned the *Shark* tribe; which in respect of ferocity and voraciousness, may be classed with the tiger, or any kindred species on land. The influence of climate on marine animals is further shown, as we have said, by the enormous size of many of the Tropical shell-fish and mollusca. The colouring of these and also of other productions of the Equatorial seas, often exhibits so much lustre and beauty, as to rival the most splendid of the feathered race. In temperate climates, and from the equal temperature of the sea, even within the frigid zone; it is remarkable that fish, like terrestrial animals, are much disposed to be gregarious. The shoals of *Herring*, *Mackarel*, and other well known visitants of our coast, are familiar examples of the gregarious tendency. The *Salmon* and the *Sturgeon* may be adduced as instances of fish inhabiting chiefly the rivers of the temperate and cold countries. While in the same climates, instead of the magnificent *Pearl oyster* of the Tropics, there appears our common *Oyster*, so diminutive and unsightly, yet so profitable to man.

We have thus seen that animals, like plants, have in general been adapted to particular climates. The numerous cold-blooded animals of the Tropics—even the warm-blooded Tiger itself, amid the Polar

snows would instantly perish. The Arctic bear would be not less unable to live, under the scorching rays of a vertical sun. Yet though adaptation to one climate be the general law regarding animals as well as plants; some species of animals have as remarkably as some species of plants, the faculty of accommodating themselves to all climates. These species, like the plants similarly endowed, are for the most part natives of temperate climates; the transition from such climates to either extreme, being much less violent than from one extreme to the other. Thus our domestic animals, that have been successively introduced into the New World at various periods since its discovery, are now, in incredible numbers, spread over the whole of that vast continent, from Canada to Paraguay. The greatest increase has been of the Horse, the Ox, the Sheep, the Goat, the Dog, the Cat, and the Hog. The Rat, too, though an unwelcome intruder, has been not the least prolific. The different varieties of domestic Poultry have multiplied to an equal extent. Even insects have been introduced, and spread in like manner, as is well known to horticulturists.

Like plants, most animals also are readily domesticated, and thrive in climates similar to those of which they are natives. The most striking instance is the Reindeer; so lately as in the year 1773 introduced into Iceland, and now exceedingly numerous in the interior of that country. From these powers of accommodation to climate, from the agency of man, and from accidental causes; the distribution of the larger animals over the globe has, in comparatively recent times, been very much modified. Nor is there any reason to believe that the distribution of these animals is yet stationary; but, on the contrary, that their distribution will undergo still further changes.

Among the more remarkable habits of animals, may be noticed the *migratory* propensities of certain species. The migration of land animals is, of course, always much limited, and may be entirely prevented by natural obstacles—the asperities of the earth's surface—sands—deep rivers—or other large accumulations of water. But many birds and even insects, possessing powerful locomotion, and whose course is through the air, may literally be said to follow the sun in their migratory progress. It is hardly necessary to state, as examples, the birds of passage, so well known as the Swallow and the Cuckoo. These birds during the summer months visit our northern climate, and feed on insects, whose multiplication would otherwise be boundless. Having fulfilled their office here; on the declination of the sun, they again retire to the south; and are succeeded by different birds from countries still further north. Such are the Woodcock and others, which escape to our shores from the rigorous cold of a Polar winter. Nor is migration confined to the higher classes of animals. The wonderful powers of flight possessed by many insects, enable them to travel over an immense extent of

country. The Locust and the Ant tribe are familiar examples. These insects occasionally migrate in countless swarms from the lands to which they are indigenous, and lay waste others far remote.

Equally remarkable is that habit of animals termed *Hybernation*. Like the plants of temperate climates, some animals have the faculty of passing the colder season of the year in a state of sleep. The Hedgehog and the Dormouse may be mentioned as examples of quadrupeds possessing this faculty. Additional instances might be given in all the classes of animals. Nearly allied to Hybernation, is that remarkable instinct which guides many of the inferior animals to deposit their eggs in the earth, or in some other place of safety; that they may be preserved during the season of diminished temperature. This instinct is particularly observable in insects whose lives are ephemeral, or are, at the utmost, prolonged for a summer.

There is yet another circumstance that remains to be noticed, as being connected with the adaptation of animals to the climates in which they live; namely, the *Clothing* or covering with which they have been supplied by nature. Every one is acquainted with the general fact, that wool, fur, eider-down, and similar articles, are obtained for the most part, not from the copious source of every superfluous production, the countries within the tropics, but from the cold, and comparatively unprolific regions of the temperate and of the frozen zones; where they have constituted the appropriate vesture of different animals. Perhaps, in the whole range of creation there is not anything more calculated to excite our admiration. However we may view these means of guarding animals from being injured by the cold; whether as a part of that conservative faculty with which animals have been endowed, and by which their existence is maintained; or as an immediate act of Providence; still the adaptations are so striking and obvious, as to render it impossible to doubt for a moment, that they have all been contrived for the purpose which is accomplished; and that they are the results of foreknowledge and of design.

We have thus given a rapid sketch of the distribution of animals over the globe. In this sketch we have endeavoured to point out the wonderful adaptations of the several classes of animals to the circumstances in which they are placed; together with the beautiful symmetry and equilibrium exhibited in zoology, not less than in the arrangements of inanimate matter. Throughout we have intentionally, and as far as was possible, avoided those details, the consideration of which belongs to other departments. But it has been our aim to state such prominent facts, as appeared best calculated for the elucidation of our argument. In particular, it has been our desire to show—how number among the weak is made to compensate with magnitude among the strong; how exuberance in one species is made to contribute to the existence of another; how orna-

ment and boundless profusion characterise the countries within the tropics, while the temperate climates are not less distinguished by utility and capacity for change; how, even in the rigorous and barren neighbourhood of the Poles, where life becomes a struggle for existence, animals have been expressly furnished with clothing appropriate to these regions;—in short, we have endeavoured to demonstrate, how every animal, in every climate, has its day; and by some peculiar contrivance, has been enabled to maintain its rank in creation, and to assist in preserving the general equilibrium.

Hitherto we have considered the works of nature without reference to *Man*. For aught we can see to the contrary, they might all have existed, and every arrangement and operation might have been very nearly, if not exactly, the same as at present; though man had never been called into being. But still, for a moment longer, keeping man's existence out of view; let us, as under a former division of this Treatise, inquire, what would have been the *use* of all this elaborate design, without an ulterior object. Would an intelligent Creator have made such a world, and have left it thus incomplete? It is evident that the other beings inhabiting this earth, live and die, without in the slightest degree comprehending the vast system of which they constitute a part. Hence they are merely unconscious agents, from which their Maker, while he has furnished them with the instincts necessary to their existence, and has awarded equal justice to all, has yet chosen to withhold the privilege of reason. That a Creator, evidently as benevolent as he is wise, might, for his own gratification, have made such a world, and without any other inhabitants, is indeed possible. But, even admitting that possibility, the probability surely is, that he would not there have finally "rested from his labour." His benevolence would have prompted him to communicate to other beings a portion of the gratification, which he himself is supposed to derive from the contemplation of his works. In the beautiful world which he had created, he would have wished to see *one* being at least, capable of appreciating to a certain extent his design and his objects. Such is a plain inference deducible from the manifest attributes of the Creator; and what is the fact? Is not man such a being as we have supposed? Throughout the world, though perfectly independent of him, is there not a clear foretoken of his existence? Has he not been placed at the head of that world, so obviously prepared for him, and thus constituted "the Minister and Interpreter of nature?" Surely no one will be inclined to doubt that such is the situation of man in the world. Equally undeniable, is the striking accordance of these deductions from the view of external objects, with what is written of the origin of man by the sacred historian: "and God said, that it (the world which he had prepared) was good. And God said, Let us make man in our own image, after our own likeness, (that is to say, endowed with reason and with the power of reflection). And let him have

dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over every creeping thing, that creepeth on the earth."

We thus arrive at another, and to us the final step in the great design of the Omnipotent: the creation and the faculties of Man.

SECTION III.

Of the present Position and future Prospects of Man.

THE consideration of the faculties of man, and of his position in the world he inhabits, belongs, in all its details, to another department. We advert to these subjects here, with the view only of completing our sketch of the physical relations of animated beings. The observations we have to offer will be comprised under two heads:—as to the means, by which man has acquired and maintains the *ascendency* he enjoys:—as to the conclusions to be drawn, from man's *elevated position*, as from his superior *intellectual character*.

With regard to the means by which man has acquired and maintains his *ascendency*, it may be observed, that these means are quite peculiar; and far from being such, as at first, perhaps, we might deem conducive to such an object: though when once known and understood, the beautiful design and harmony they evince, immediately become apparent.

The supremacy of man has *not* been the result of his own personal strength, nor is it so upheld. On the contrary, many animals are larger and more powerful than he is; while few of his size, are naturally so incapable of self-defence; or during so long a period suffer from the dependent helplessness of infancy and of old age. Neither is his frame superior in external adaptation to climate: for while nature has furnished other animals with clothing appropriate to the temperature in which they live, man has been brought into being absolutely naked; and moreover remains so, in every climate he inhabits, from the Equator to the Poles. Lastly, the pre-eminence of man has not been owing to his more extensive range of diet; or to his greater ability for assimilation: for though man be omnivorous in one sense of the term, he is not omnivorous according to the application of the term to other animals; that is to say, man does not eat indiscriminately of every kind of aliment, in the state in which it is afforded by nature; for even in his rudest condition, he adopts some process of cookery. How then has man gained the high station which he occupies? The answer is simply—by his *Reason*. Man has been created a reasonable being; and this endowment amply compensates to him for the want of the animal requisites of strength—for deficiency of natural covering—and for his restricted ability in assimilating his food. By his reason he is enabled to com-

mand the strength of the elephant ; to choose from every production of nature whatever is adapted for his clothing, and thus to array himself according to his pleasure, or the exigences of the climate in which he resides ; to extract wholesome nourishment from the most unpromising, even from the most deleterious articles. There was no necessity, therefore, why man should himself be as unwieldy as an elephant ; or be encumbered with any vestures that in some situations might be oppressive ; or be able to digest, without culinary preparation, any coarse and intractable substances. Thus, mere animal endowments not being requisite, the Creator's wisdom has been displayed in another manner, and with a wider scope. In furtherance of his design, He has limited the bulk of the human species to that happy medium, combining strength with convenience ; and to an organization delicate and sensitive in the highest degree, but nevertheless accommodating, He has superadded a form at once peculiar, appropriate, and beautiful !

When speaking of temperate climates, we remarked, that they seemed to be characterised by the utility of their productions ; and that the plants and animals of these climates, generally possessed greater powers of accommodation than those of either of the extreme climates. Now Man, by an express arrangement of his Maker, has apparently been constituted a native of temperate climates ; and only in these climates can his powers be said to be completely developed. Within the tropics, indeed, human existence is flourishing ; for there the immediate bounty of Providence affords to man a copious and admirably adapted nutriment. Yet in the midst of that profusion, and without any adequate motive to call forth exertion, his reason too often languishes ; while his animal tendencies predominate ; and his life is spent in apathy and in sensual gratifications. On the other hand, under the cheerless sky of the frigid zone, imperfectly nourished by scanty and unsuitable food, the powers of his mind, like those of his body, are stunted ; or are engaged solely in combating the rigours of his situation. But in the temperate climates the evil consequences of both these extremes are avoided, while the beneficial influences of climate remain. Urged by the stimulus of necessity, and at the same time having at his command the astonishing capability of nature, man is, in temperate climates, surrounded by motives of every kind, and his faculties thus attain their utmost developement. As familiar examples of the effect of this expansion of the human reason, let us view man under the three aspects to which we have before alluded ; namely, with reference to his *strength*, his *food*, and his *clothing*, inclusive of his *habitation*.

In the first place, with regard to his strength. The strength of man is not only that which is his own, almost infinitely magnified by ingenious mechanical devices of every kind, and of every degree, up to the stupendous agency of steam ; man has, moreover, subdued to his service many of the larger animals, while those which he can-

not so appropriate, he destroys. As weapons, he wields every instrument offensive and defensive, from the rude but effective club or arrow, to the warlike engines to which he has applied the discovery of gunpowder. Whatever his wants require, he obtains by tools; from the humble spade, to that perfection of machinery, which almost rivals the operations of intelligence itself. In the next place, view man with reference to his food: what wonders has not his reason enabled him to achieve among the fellow inhabitants of his own temperate climate. In the vegetable kingdom, let us consider the astonishing mutations and increase of the *cereal*ia, or corn tribes; the transformation of the sour and forbidding Crab into the rich and fragrant Apple; of the harsh and astringent Sloe into the delicious Plum; of the coarse and bitter sea-side *Brassica* into the nutritious and grateful Cauliflower: all which changes, and numerous others of a like kind, have been effected by man. Nor have the transformations which he has produced among animals been less wonderful than those among vegetables. All the numerous varieties of cattle, of sheep, of horses, of dogs, of poultry, and of all the other animals reared as food, or for any purpose domesticated, have sprung from a few wild and unattractive species; and have been made what they are, in a great degree, by his intervention. Moreover, the most useful of these varieties of animals have been transported by man into every region of the globe, to which he has himself been able to penetrate. Lastly, in the clothing and habitations of man, the surpassing influence of his reason is equally conspicuous. For covering his naked body, a surface of considerable extent is necessary; larger, indeed, than is presented by any natural texture, unless, perhaps, by the skins of other animals, or by the leaves of some plants; which therefore, in the rudest state of society, usually constitute his only dress. But by the art of *weaving*, he has been enabled to produce garments of any size, and from materials that would seem the least fitted for such conversion. Thus man can not only clothe himself in any manner, and according to the temperature of the climate in which he lives; but he can associate with the articles of his dress every species of ornament which his fancy may dictate. His choice of materials for the construction of dwellings is not less extensive than that of his clothing. As climate and other circumstances may require, he abides in the humble cabin, or in the splendid palace; in the temporary hut, or in the enduring castle, formed to withstand alike the tempest of war, and of the elements.

Such is man, and such are a few of those great changes in this world, which, under the guidance of his reason, he has had the power to accomplish. And what a splendid evidence of design and of preconcerted arrangement on the part of the great Creator is thus exhibited, by viewing the inherent properties of matter, and its various conditions, with reference to the works of man. Had water, for instance, not been constituted as it is, man could never have formed

the steam-engine. Had not the productions of the temperate climates been formed with that capability for change, by which they are so much distinguished, man could never have so moulded them to his uses, by altering their character. There was no reason why such properties should have been communicated; there was even no reason why the objects in which these properties exist, should have been created. But they have been so created; and what are we to infer? No one surely will contend that they have been the result of chance, or have been created without an object. They must therefore have been created with design; and if with design—most obviously with design having reference to the being man, *not yet in existence*.

Thus far have we considered the state at which the earth has arrived, and man, an animal endowed with reason, placed as its chief inhabitant. But we may yet extend our view to the prospects in *futurity*.

We have seen that this earth has not suddenly emerged from chaos to its present condition; but that by a succession of violent and disruptive changes, it has been progressively brought into different conditions, and progressively tenanted by higher orders of beings. We, the last of the series, in our own creation and in the faculties with which we have been endowed, behold the most striking exemplification of the wisdom, and of the power of the Deity. But does the great design abruptly terminate here? Has this earth arrived at the ultimate stage of its existence? Have its inhabitants attained the utmost perfection of which they are capable? Are there no further convulsions, and still higher orders of beings in contemplation? The answers to these questions are known only to the great Author of the universe, and concern us not. There is one question, however, connected with this subject, in which we are deeply and personally interested—*What is to become of man?* Is the being who, surveying nature, recognises to a certain extent, the great scheme of the universe; but who sees infinitely more which he does *not* comprehend, and which he ardently desires to know;—is he to perish like a mere brute—all his knowledge useless; all his most earnest wishes ungratified? How are we to reconcile such a fate with the wisdom—the goodness,—the impartial justice—so strikingly displayed throughout the world by its Creator? Is it consistent with any one of these attributes, thus to raise hopes in a dependent being, which are never to be realized? thus to lift, as it were, a corner of the veil—to show this being a glimpse of the splendour beyond—and after all to annihilate him? With the character and attributes of the benevolent Author of the universe, as deduced from his works, such conceptions are absolutely incompatible. The question then recurs—*What is to become of man?* That he is mortal, like his fellow creatures, sad experience teaches him; but does he, like them, die *entirely*? Is there no part of him, that surviving the general wreck, is reserved for a higher destiny? Can that, within man, which reasons like his immortal

Creator—which sees and acknowledges His wisdom, and approves of his designs, be mortal like the rest? Is it probable, nay, is it possible, that what can thus comprehend the operations of an immortal Agent, *is not itself immortal?*

Thus has reasoned man in all ages; and his desires and his feelings, his hopes and his fears, have all conspired with his reason, to strengthen the conviction, that there is something within him which *cannot die*. That he is destined, in short, for a future state of existence, where his nature will be exalted, and his knowledge perfected; and where the GREAT DESIGN of his Creator, commenced and left imperfect here below, WILL BE COMPLETED.

BOOK III.

OF THE CHEMISTRY OF ORGANIZATION : PARTICULARLY OF THE CHEMICAL PROCESS OF DIGESTION ; AND OF THE SUBSEQUENT PROCESS BY WHICH VARIOUS ALIMENTARY SUBSTANCES ARE ASSIMILATED TO, AND BECOME COMPONENT PARTS OF, A LIVING BODY.

HAVING in the foregoing pages, given a summary view of the Chemical properties of bodies not organized, and of the laws of their union ; having also considered the general relations of inanimate matter and of organized beings, on the great scale in which they are offered to us by nature, together with the present position and future prospects of man ; we now proceed, in the last place, to inquire more particularly into the means by which organization is accomplished ; or, in other words, to give a summary view of those chemical properties, and laws of union, by which organized beings are distinguished from inorganic matters.

CHAPTER I.

OF THE NATURE AND COMPOSITION OF ORGANIZED BODIES IN GENERAL, AS COMPARED WITH INORGANIC MATTERS.

“ A LIVING being considered as an object of chemical research, is a laboratory, within which a number of chemical operations are conducted ; of these operations, one chief object is to produce all those phenomena, which taken collectively are denominated *Life* ; while another chief object is to develop gradually the corporeal machine or Laboratory itself, from its existence in the condition of an atom, as it were, to its utmost state of perfection. From this point of utmost perfection, the whole begins to decline as gradually as it had been developed ; the operations are performed in a manner less and less perfect, till, at length the being ceases to live ; and the elements of which it is composed, again set free, obey the general laws of inorganic nature.”*

Such is the history of organic existence ; nor, though the periods of development and of decay be infinitely varied in different spe-

* Berzelius, *Traité de Chimie*, tom. v. p. 1.

cies, does a single individual remain for a moment stationary; but all, sooner or later, transcend their prime, and finally share the common lot of dissolution.

That peculiar principle or principles, which under some condition or other, exists in all organized beings, and by which they are distinguished from inanimate matter, has received various appellations. In the present inquiry these principles may be viewed as agents: and to discriminate them from Heat, Electricity, and other agents or inorganic matters, they may be denominated *organic agents*. In conducting our investigations into the nature of these principles or agents, our difficulty will be much lessened, by endeavouring previously to have a clear understanding of what these agents actually do. We shall, therefore, in the first place, give a short sketch,

1. *Of Organic Bodies considered as Chemical Compounds.*—In their well-marked forms no two things perhaps can be conceived to offer a stronger contrast, than the two great divisions of organic bodies—vegetables and animals. Yet these two kinds of bodies so gradually approximate, and seem even to coalesce, that it is not possible to say where the one ends and the other begins. The same remark applies to the chemical composition of vegetables and animals. Vegetable substances, in general, contain essentially no more than three elements, *Hydrogen, Carbon, and Oxygen*; while animal substances usually involve a fourth, *Azote*. Yet there are many vegetable substances, of whose composition, azote forms a considerable part; while certain animal substances are entirely wanting in that principle. It is obvious, therefore, that the mere chemical composition of a substance, at least its essentially consisting of three or four of these elements, will not enable us to determine whether it be vegetable or animal; and that, in many substances, when this point happens to be doubtful or unknown, we must have other data before we can form a conclusion. Besides these four elements, of which all organic substances are essentially compounds; other principles generally enter into their composition. These other principles are in very minute quantity, and are not so essential to the actual existence of organic substances, as the four constituent elements above named; yet, however minute the quantity, the influence of these other principles seems to be most important; they are, *Sulphur, Phosphorus, Chlorine, Fluorine, Iron, Potassium, Sodium, Calcium, Magnesium*, and probably more besides. These principles, have, by most chemists, been deemed extraneous, or foreign to organized bodies; but we shall presently show, that there is good reason to believe, that the office of such additional principles, though different from that of the constituent elements, is nevertheless most remarkable. These four elements, along with the additional principles, are, in the present state of our knowledge, alike denominated, *The Ultimate Elements* of organized bodies; but hydrogen, carbon, oxygen, and azote, may be termed, for sake of distinction, the *essential ele-*

ments ; and sulphur, phosphorus, &c. the *incidental* elements of such bodies. The combinations of these ultimate elements with one another, according to certain laws, produce what are denominated the *Immediate*, or *Proximate Elements* of organized bodies. Of these proximate elements, *Sugar*, *Oil*, *Albumen*, &c. are familiar examples.

Perhaps it may be stated as a general law, that no substance, entering into the composition of a *living* plant or animal, is so pure as to be capable of assuming a regularly crystallized form. Instead, therefore, of being defined by straight lines and angles, almost all solid organized substances are more or less rounded, and their intimate structure is anything but crystallized. The composition of organized fluids is equally heterogeneous ; and though the basis of nearly every one of such fluids be water, many of them contain a variety of other matters.

Organized bodies may be ranged under two general classes ; those which though they do not crystallize, while in the living plant or animal, can yet, by various processes, be so far separated from extraneous matters, as to be obtained in a state of purity, and thus be made to assume the crystallized form ; and those which cannot under any circumstances be made to crystallize. The first substance of the crystallizable class which we shall notice, is *Sugar*.

Sugar has been ascertained, and is now generally admitted, to consist of three essential elementary principles—hydrogen, oxygen, and carbon ; it is besides remarkable, that the hydrogen and the oxygen in sugar are exactly in the proportion to each other, in which they form water. It has been, therefore, with great probability inferred, that these two elements are really so associated in sugar ; consequently, that sugar is a compound of water and carbon ; or, in the language of Chemists, is a *Hydrate* of Carbon. We cannot, however, produce artificially either sugar, or any other organic compound, by directly combining their elements ; because we cannot bring the elements together, precisely in the requisite states and proportions. Still, there is no doubt that if the elements could be so brought together, the compound thence resulting, would be the same as the natural compound. For, as hereafter we shall endeavour to show, the organic agent does not change the properties of the elements ; but simply combines them in modes which we cannot imitate.

Vinegar is another well known proximate principle, which not only forms crystallized compounds readily with many other bodies ; but in its most concentrated state, is itself also crystallized. Now, it is not less worthy of note than in the case of sugar, that vinegar, altogether so different from sugar in its properties, is generally considered to be precisely analogous in its composition ; that is to say, vinegar is a binary compound of water and carbon ; but the proportions of water and carbon are different from those that form sugar. There is however, a characteristic distinction between these two substances, inasmuch as vinegar can be formed artificially ;

not indeed, any more than sugar, by directly associating its elements; but, by the process of fermentation, and by other means, this acid may be formed from sugar and from the allied substances to be presently mentioned. Yet we cannot work backwards, and by any artificial process again form sugar from vinegar; though the organic agent seems to possess this power, as we shall have occasion to notice more particularly hereafter.

We now proceed to consider the composition of a totally different class of substances, which under no circumstances, natural or artificial, ever assume the crystallized form; and the structure of which, in the common and strict sense of the term, may be said to be *organized*. *Starch* is a well known instance of these uncrystallizable or organized substances.

The amylaceous or starchy principle is obtained in slightly modified states, from a great variety of vegetables, but principally from the seeds of the *Cerealia*. Even by the unassisted eye, starch is seen to be composed of minute particles; and when these particles are examined with a microscope, they are found to be granules more or less rounded, and without the least trace of crystallization. These granules are conceived to be moulded in the cellules of the texture by which they are formed; for it would appear that their state when first secreted and deposited in the cellules is semifluid; and that the excess of water is subsequently removed. Raspail and Dumas have shown that each of these little grains is covered with a smooth integument, not affected by water at the common temperatures; within which integument is enclosed a substance rather more soluble. According to some chemists, this interior substance has an analogy with gum; but probably it is only a variety of amylaceous matter. Berzelius affirms that starch when burnt, leaves about .23 per cent. of residuum, consisting entirely of the phosphates. But when this residuum is abstracted and allowed for, the essential composition of starch is found to coincide very nearly with that of sugar; that is to say, starch is composed of water and carbon, and the proportions of their combination are very nearly the same as in sugar. Here a question arises; How does it happen that substances which appear to resemble each other so closely in their composition, should yet differ so widely in their sensible properties? This question we shall soon consider. But in the mean time, we shall make a few remarks on another principle of organized bodies, still very different, in its sensible properties, from the three of which we have spoken, but apparently of a similar constitution. This fourth principle is the *woody fibre*, or *Lignin*, as it is termed by chemists.

The woody fibre, though assuming a great variety of appearances in different plants, and including very different incidental matters; has nevertheless, in all those plants in which it has yet been examined, been found to possess very nearly the same essential composition; or to consist of equal weights of water and of carbon.

Such, at least, is the composition of woods, so very different as the Box and the Willow, the Oak and the Beech; and these are the chief, if not the whole, of the woods which, we believe, have yet been analyzed. Hence, it is perhaps not unreasonable to suppose that every variety of Lignin has a similar composition. All woods, when burnt, leave a greater or less quantity of incidental mineral residuum, in the shape of ashes; the nature of which, as above observed, differs exceedingly in different sorts of wood.

The following Table presents a summary view of the composition of the four organic principles which we have considered in the preceding paragraphs. It is offered, not only as an example of the boundless subject of the Chemistry of Organization, but as an instance of the mode by which we conceive, that department of Chemistry may be best elucidated.

<i>Substances Crystallizable.</i>			<i>Substances not Crystallizable.</i>		
	Carbon.	Water.		Carbon.	Water.
SUGAR, from			STARCH, ARROW-		
Starch - -	36.20	63.80	root in its		
from Honey	36.36	63.63	ordinary		
East India			state - -	36.4	63.6
Moist - -	40.88	59.12	from Wheat,		
Beet root and			in its ordi-		
Maple - -	42.10	57.90	nary state	37.5	62.5
English Re-			ditto, ditto,		
fined - - -	41.5 to 42.5	58.5 to 57.5	dried at		
Pure Sugar			212° - -	42.8	57.2
Candy - -	42.85	57.15	- - - - -		
ACETIC ACID -	47.05	52.95	LIGNIN, in its or-		
- - - - -			dinary state		
			of dryness	42.7	57.3
			from Willow,		
			dried at		
			212°.	49.8	50.2
			from Box, do	50	50

A cursory inspection of the foregoing Table will evince to the reader, how nearly the general composition of sugar and of starch agree together; and that the agreement extends even to their several varieties. Vinegar, or acetic acid, has not, at present, any known representative, among other organic principles; though it is not improbable that several substances exist of conformable proportions. The composition of vinegar, or acetic acid, is intermediate to that of sugar and of Lignin; while among crystallizable organic substances, there is no known compound analogous to Lignin. It may, at the same time, be remarked, that both starch and wood can,

by different artificial processes, be converted either into sugar or into vinegar. We can also convert wood into a sort of starch, as we may convert sugar into vinegar; but we are unable to reverse the process, and convert vinegar into sugar, or starch into wood; though these and innumerable changes of a similar kind are easily affected by organic agency.

We proceed now to consider briefly the question we have already stated,

2. *How does it happen that substances, so nearly allied in their composition, exhibit sensible properties so entirely different?*—This question, in all its bearings, is probably beyond our powers of investigation: at least the extent of the requisite knowledge we have yet attained, must be allowed to be exceedingly inadequate. The few observations which we have to offer regarding this question may be comprised under the two following heads:—The *peculiarity of the composition* of organic substances; and the *nature of the agents* by which these substances are produced.

The *composition* of organized bodies may be viewed as of two general kinds, viz. their composition, as depending simply upon differences among the proportions of their essential elements; and their composition as depending upon differences among their incidental elements, the proportions of the essential elements being the same.* As instances of the first kind of composition, we may mention sugar and vinegar. Thus, sugar is composed of 42.85 per cent. of carbon, and the rest water; while the same ingredient, carbon, in the larger proportion of 47.05 per cent., with the residue water, constitutes vinegar, a powerful acid. Why, with such similarity of composition, the sensible properties of these two substances should be so unlike, we know not; any more than we know why oxygen and hydrogen, when combined, form water, or than we know any ultimate chemical fact. However wonderful, therefore, the results of these slight differences of composition may, at the first view, appear; a little reflection will convince us, that in reality, they are not more wonderful than any other chemical phenomenon; and that they only form a particular variety of such phenomena. The same remarks are applicable, in part at least, to the striking differences exhibited by Sugar and Starch; the essential composition of which two substances, as we have before observed, is nearly the same; but the starch contains incidental bodies, from which the sugar is free. On the operation of these incidental bodies we shall offer a few conjectural remarks.

At the commencement of this chapter, we stated that the incidental substances existing in organized bodies have hitherto been

* Of course there is a third, and perhaps the most extensive class of bodies, in which both the essential and the incidental elements may be supposed to vary; but partly from want of data, and partly to avoid too much complication, we shall not enter upon the consideration of this class at present.

considered as foreign; but that we could not subscribe to that notion. We may now observe, that they seem to us, to contribute chiefly towards the production of those striking differences, observed among bodies having the same essential composition; and which diversity, at first sight, appears so mysterious. How these minute quantities operate we do not precisely understand; but we can imagine them to be interposed among the constituent molecules: further, that the molecules of these incidental matters are in a state of strong self-repulsion. Such being the case, it is not unreasonable to expect that they may have the power of modifying the arrangement of the constituent molecules; and thus of altering the sensible properties of the substance produced by their combination.

We have stated our opinion that the molecules of incidental matters in organic substances are in a state of self-repulsion. This opinion is founded principally, on the equal diffusion of these incidental molecules throughout the organic substances in which they exist; and on their consequent great distance from each other, which, perhaps, can hardly be otherwise explained. If these incidental matters were detached, or merely in a state of mixture with the constituent elements, as is implied in the notion of their being foreign, they would probably retain their self-attractive powers; and instead of being equally diffused among the constituent elements, they would be collected together into a mass or crystal; an arrangement never observed. For, though crystallized bodies are found, not unfrequently, within organized substances; yet these bodies are always extraneous, and do not form any part of the living structure; of which, the molecules under our consideration do actually appear to be integrants. In further corroboration of this opinion, may be adduced the beautiful experiments of Sir John Herschel, who has shown, that an enormous power, not less than 50,000 times the power of gravity, is instantaneously generated by the simple agency of common matters submitted to galvanic influence; as, for example, by the agency of mercury alloyed with a millionth part of its weight of sodium. These facts, while they place beyond all doubt, the efficacy of minute quantities of matter, in producing the most extraordinary change of the polarities of larger quantities; at the same time appear to throw great light on many natural operations. Thus the subtle matters of contagion and miasmata; various medicinal substances, whose effects are most astonishing even in the smallest doses; the still more refined and recondite matters of heat and of light, with many others, all probably act on similar principles. At least, the results of the operation of these matters cannot be explained by their mere quantity; which in the ordinary chemical acceptance of the term, is altogether incommensurate with the evident and striking changes, constantly arising in the processes of nature, from such agency.

The observations that have now been offered, are intended to

apply to all those elementary substances, entering into the composition of a living organized being. For, no one element, when thus assimilated, appears to be in its natural state; or to be capable of exerting precisely those powers which it is known to exert, when acting in virtue of its original inorganic properties. In short, we may thus recapitulate what has been said; besides the essential molecules constituting the ground-work of a living organized being, and which probably exert on each other, to a certain extent, the ordinary chemical influences of matter; it would seem that there are, at the same time, diffused throughout the whole living mass, in exceedingly minute proportion, various other matters, the molecules of which appear to be in a high state of self-repulsion. By these incidental matters, it would further seem, that the ordinary chemical properties of the essential elements of the organized living structure are variously modified; in particular, that, the essential elements are hindered from assuming a regularly crystallized form. Moreover, these incidental matters entering into the composition of a living body, apparently furnish to the organic agent new powers utterly beyond our comprehension; which powers the organic agent has been endowed with the ability to control, and direct, in any manner that, from the exigences of the living organized being, may become requisite.*

The intimate nature of the *organic agent* or *agents*, or by whatever other name we may choose to designate the peculiar energies which exist in plants and in animals, and by which they are distinguished from inanimate matter, is now, and probably will ever remain, altogether unknown to us. But though we be thus ignorant of what these agents are; we can not only comprehend with tolerable certainty, what they *are not*; but we can also in some degree ascertain, what they are capable or incapable of effecting. As it is of the utmost consequence to obtain just views on these points, we shall consider them somewhat in detail.

When we were treating of inorganic elements and agencies, and of the laws which they appear mutually to obey, we found, that though their nature be obscure, and the investigation of them very difficult; we were nevertheless enabled to adduce some, not altogether unpalatable, conjectures on the modes, in which the elements combine, to form regular crystals and the other conditions of inanimate matter. Now with this insight into the nature of inorganic operations, and with all the additional knowledge of every kind that we can command, let us attentively survey the most simple plant or animal; let us observe the actions, the changes, the modifications of form and properties it continually exhibits; and then let us seriously

* In addition to what is stated in the text, we may remind the reader of what we have elsewhere alluded to, viz.: that the organic agents have probably the power, within certain limits, of separating the molecules of bodies, considered at present as elementary, into more refined forms of matter (submolecules?).

ask ourselves, whether every thing that we know will enable us to make, even an approach, toward an explanation of what we see. It is indeed true, that the plant or animal we examine is composed of charcoal and water, and of other ingredients with which we are equally familiar; that it is liable to be affected by Heat, Light, Electricity, and by other inorganic agents. But it is perfectly ascertained that these elements and agents, out of an organized body, *and left entirely to themselves*, never would or could unite, either in virtue of their own properties, or from accident, so as to form any plant or animal however insignificant. Are we not then compelled to infer, that within a plant or animal, there exists a principle or agent superior to those whose operations we witness in the inorganic world; and which agent moreover possesses, under certain restraints, the power of controlling and directing the operations of these inferior agents? That this is a natural and a just inference, no one who calmly views all the circumstances will ever deny; and if the existence of one such agent be admitted, the admission of the existence of others can scarcely be withheld; for the existence of one only, is quite inadequate to explain the infinite diversity among plants and animals. Thus, in the words of the excellent Paley, "there may be many such agents, and many ranks of them:" in other words, there may be an ascending gradation of these agents, from that of the comparatively simple plant, onward to that of the most complicated animal.

Such being the suggestions concerning organic agency that arise from a general survey of organic operations; let us, with reference to the further bearing and tendency of these suggestions, inquire a little more minutely into the powers and modes of operation of organic agents.

3. *Of the modes of Operation of Organic Agents.*—In the first place, with regard to what *cannot* be effected by organic agency, we may observe, that no organic agent has the power either of *creating* material elements, or of *changing* one such element into another. By element, it may be right to premise, is here meant, a principle that is not made up of others; and which, consequently, possesses an absolute and independent existence. Whether one, or more, such elements exist, it is not now our object to inquire. The astonishing discoveries of modern chemistry have shown, that many of those substances, formerly considered as elements, are, in fact, compounds; and as the science of chemistry is still progressive, it is probable that, with the enlargement of its boundaries, there will be a still further diminution of the number of those substances which are, as yet, held to be simple. Admitting, however, for the sake of argument, that elementary principles do exist, of such immutable character as has been supposed; from the nature of organic beings, at least of all animals, it is impossible to conceive that they possess the power either of creating or of altering these elementary principles.

For no organized being has an independent existence, but all animals derive their support from previous organization, which might be otherwise, did they possess a creating power; nor can they be nourished by all substances indiscriminately, as they ought to be, were they possessed of a transmuting power. Yet, while it is thus denied that organized beings possess the power, either to create or to change, in the strict acceptation of these terms; it has been admitted to be exceedingly probable, that the organic agent is, within certain limits, qualified to compose and decompose many substances which are now viewed as elements; and that the organic agent does thus apparently form and transmute these imagined elements. But to enter further, in this place, on the elucidation of these obscurities would be foreign to our present purpose.

The organic agent has not the power of combining elements in such a manner, that the properties of the resulting compound shall *differ* from those of a compound, formed from the same elements similarly combined by any other agent. The Deity has chosen to prescribe limits to his power, and to establish certain laws, to which He at all times rigidly adheres; and, again adopting the language of Paley, "when a particular purpose is to be effected, it is not by making a new law, nor by the suspension of the old ones, nor by making them wind, and bend, and yield to the occasion; but it is by the interposition of an apparatus corresponding with those laws, and suited to the exigency which results from them, that the purpose is at length attained." In the instance before us, the attainment of the particular purpose of organic life is effected, not by any departure from the great scheme, but by new and different combinations. To suppose, therefore, that the organic agent can, for example, combine oxygen and hydrogen, in exactly the same proportion, and in the same manner, in which they are combined, when they exist as water; and, from these elements so combined, can yet produce something different from water, is contrary to all reason, and would be, in truth, to accuse the Deity of subverting, and of acting in opposition to, his own laws. We have dwelt the more strongly on these points, because among physiologists a vague notion seems to have prevailed, that organic agents have the power, not only of changing the inherent and peculiar properties of bodies; but likewise, of causing the results of their combination to be altogether different from those that are produced, under exactly similar circumstances, by inorganic agency. If however the arguments we have advanced be well founded, this notion must be erroneous; and its erroneous character will be rendered still more evident, by the observations, we shall, in the second place, offer, regarding the principles on which the operations within living organized bodies are really conducted.

The means by which organic agents accomplish the purpose for which they are designed, may be naturally divided into two kinds;

those which are dependent on *peculiarity of composition and of structure*; and those by which *this peculiarity of composition and of structure is produced*.

Inquiry into the *first* of these means of action has already been in great degree anticipated. A brief recital, therefore, is all that is here necessary. We have seen that organized substances are composed of the same elements, which exist abundantly throughout the world in the inorganized state; moreover that these elements are subject to all the influences and agencies of inorganic nature. We have seen that organic agents are enabled to form certain proximate principles, by variously combining their elements; which proximate principles, even when in the condition of crystals, it is not possible to imitate artificially. We have, at the same time, seen that these proximate principles, though they may have a natural tendency to crystallize, are, as they usually exist in living bodies, prevented from undergoing that process, by the diffusion of minute quantities of other elements throughout their mass; the molecules of which are in some unknown state of activity; such perhaps as cannot naturally exist in the universe, except when conjoined with organization. Finally, we have inferred, that the differences and peculiarities, of these minute additional matters, are probably adequate for explaining the differences and peculiarities, of the sensible and chemical properties of the substances that are formed by organization. Having thus pointed out the general differences of composition existing among organized bodies; it remains to state, that such differences of composition almost invariably indicate differences of structure. For though similarity of composition does not necessarily imply similarity of structure; yet similarity of structure perhaps, without exception, indicates similarity, or, at least, analogy of composition; and, consequently, *similarity of action*. Thus the woody fibre of plants is always formed of the principle termed *Lignin*, and never of resin, or of albumen. The relation of structure to chemical composition is not less striking in the muscular fibres of animals, and indeed in all organic compounds of a definite character; the essential composition of such substances, though exhibiting endless minor diversities, being nevertheless, in all instances, precisely the same.

The means by which that *peculiarity of composition and of structure is produced*, which is so remarkable in all organic substances, like the results themselves, are quite peculiar; and bear little or no resemblance to any artificial process of chemistry. For example, we have not, in artificial chemistry, any control over individual molecules; but are obliged to direct our operations on a mass, formed of a large collection of molecules. The organic agent, on the contrary, having an apparatus of extreme minuteness, is enabled to operate on each individual molecule separately; and thus, according to the object designed, to exclude some molecules, and to bring others into contact. In these processes, it may be conceived,

that the molecules thus appropriately brought together, and, at the same time, guarded from extraneous influence, by the organic agent, are in virtue of their own proper affinities, sufficiently disposed to unite, without requiring that any new properties should be communicated to them. Hence the organic agent, in its simplest state, may be viewed as a power which so controls certain inorganic matters, as to form them into an apparatus, by which it arranges and organizes other matters, and thus effects its ulterior purposes. Where the operations of this simple organic agent terminate, those of another and more effective organic agent may be supposed to begin; which, by carrying the general process of organization a step further, adapts the organized material for the operations of a third and yet higher agent. Thus, each new agent may be supposed to possess more or less control over all those below itself, and to have the power of appropriating their services; till at length, at the top of the scale, we reach the perfections of organized existence. The excellent Paley sanctions this view of organic operations, and continues in the following words: "We do not advance this as a doctrine either of philosophy or of religion; but we say that the subject may safely be represented under this view; because the Deity, acting himself by general laws, will have the same consequences upon our reasoning, as if he had prescribed these laws to another."

This view of the successive creation of organic agents, which harmonizes not only with the phenomena of Geology, but with the differences which are observable among plants and animals, and with the developement of the more perfect species; is directly opposed to the notion of spontaneous developement maintained by some distinguished French philosophers; as well as to the opinion that life is the *result* of organization. Thus we consider it impossible that by any accidental concurrence of circumstances, a dog can, in the progress of time, be gradually converted into an ape, or an ape into a man; and moreover, we not only think such an hypothesis directly at variance with the whole tenor of the laws of nature, but quite absurd. The laws of nature, as we have shown, are in all cases most rigidly adhered to by the Deity. These laws, therefore, are unalterably stable, within the limits that have been assigned to them. Now, from what we know of the laws of nature, or of the properties of the elements of matter, or of the agents by which they are moved, it is, as we have already stated, impossible to conceive that carbon, water, and electricity, of their own accord, and from any inherent influence, can so unite as to form the humblest plant or animal; much less, so as to secure its perpetual existence by reproduction. For similar reasons it is equally impossible to conceive, that there can ever be such a spontaneous arrangement or combination of *inferior* organic agents, as to form a *superior* agent. Whenever, therefore, a new and specific agent is required, a new and specific

act of creation must be performed by the Great Architect of the universe. Nearly similar remarks apply to the opinion that the living principle is the *result* of organization. The living principle is *not* the *result* of organization, but the *cause* of organization. In accounting for the phenomena of life, it is absolutely necessary to assume the existence of some agency different from, and superior to, that which operates among inorganic matters. Now since, as we have seen, no inferior agencies can be supposed so to combine as to form a superior agency; does it not accord better with our reason, as well as with our experience, to assume at once a new creation of the higher principle?

The first circumstance that arrests our attention, with reference to the preceding remarks, is the wonderful adaptation of the elements and the agents of organic nature to each other. For example, had not carbon, and azote, and water, been formed with the properties which they now possess, organic agents, as we know them, would have existed in vain; and without organic agents, the properties of these elements would equally have been useless. And how truly wonderful, and utterly beyond our comprehension, are the properties and adaptations displayed in the processes of organization! To enable ourselves to form some conception of these processes, by bringing to a level with our understanding, those things which they accomplish; let us propose to ourselves the question,—What ought to be the inherent properties and the constitution of an elementary principle, which should not only be capable of being formed into the hardest and the softest bodies in nature; but which should also be capable of entering as an essential ingredient into substances so very unlike, as sugar, vinegar, wood, oil, albumen, and many others, in all their countless forms and varieties? Do we not feel our fancied knowledge annihilated by such a question? Nay what is more, even when the question is answered for us; and when, with the utmost care, and to the furthest extent of our ability, we have studied all the chemical properties of Carbon—the substance by which the conditions of the question are fulfilled; how totally unable are we to explain these properties, or even to trace them through their simplest modifications? Why, for instance, is the diamond capable of assuming the form of charcoal; or why is charcoal capable of assuming the form of the diamond? And how are these properties modified, and altered, in all the numerous states of combination into which we know carbon enters? On what property or quality, not possessed by other elements, do all those astonishing capabilities of change depend, which are inherent in this element carbon? And why has carbon been chosen for forming organized beings, in preference to silex, or iron, or any other element?*

*Since there is nothing peculiar in the elements of which organized beings are composed, and no reason can be assigned why carbon and other elements have

things are absolutely unknown; but what a conception do they give, of that inscrutable agency by which the elements are governed; of the powers of that Almighty Mind who is conversant with them all—by whom they were first designed, and by whom they have all been created! How infinitely must His knowledge surpass whatever we can imagine; how far is His power beyond our utmost calculation!

On the other hand, if the properties of the elements of matter be wonderful, yet more wonderful are those agents within organized bodies, by which they are directed. With the intimate nature indeed of these agents we have not the remotest acquaintance, nor, probably, ever shall have. But, as has been already stated, we can trace, to a certain extent, the laws of action which these agents obey; we observe their unvarying adaptation to the properties of carbon, azote, and water, on which they chiefly act; their power, within certain limits, of guiding and controlling inorganic agents; and more than all, that mysterious periodic developement and decay, which every organized being undergoes. These facts which continually present themselves to our notice, are totally inexplicable according to those laws by which inorganic bodies are governed; and are referable only, to an order of laws, which the Great Author of Nature has not chosen to reveal.

Lastly, we cannot close this chapter, without pointing out to the reader a very remarkable contrast, in the two classes of objects which have engaged our attention. The number and diversity of organic agents appear to be endless; in the creation, therefore, of these agents, the Great Author of Nature has chosen to manifest his attribute of infinity. But in the creation of the material elements which compose the frame of organized beings, He has adopted a plan directly opposite. Instead of different principles; the same carbon, the same azote, the same water, enter into every living being, from the lowest plant upward to man. Amidst the wonders of creation, it is perhaps difficult to say what is most wonderful; but we have often thought, that the Deity has displayed a greater stretch

been chosen for their formation, we are compelled to ascribe the choice of these materials to the will of the Great Creator. But as He never acts without a purpose, we cannot doubt that these elements have been selected for some specific design; which design has probably been, that the fabric of the beings dwelling on this earth, might be adapted to its general position in the Solar system. When we consider that the same heat, and the same light diffused by the same central sun; that the whole system obeys the same laws; and that the different planets influence, and are influenced by each other; we are warranted in believing that the planets are essentially composed of the same elementary principles. But admitting that the heat and light of the sun are distributed according to the laws which they seem universally to obey; the heat in Mercury, close to the sun, and the cold in Saturn at the other extreme, must be alike so intense, that organized beings, such as inhabit this earth, could not exist for a moment. In the different planets, therefore, may not the living principle be attached to different elements, more or less fixed or volatile, as the distance of the planet from the sun may require?

of power, in accommodating to such an extraordinary variety of changes, a material so unpromising and so refractory as charcoal, and in finally uniting it with the human mind; than was requisite for the creation of the human mind itself. To Him, however, all things are alike easy of accomplishment; and He, doubtless, has willed these and other proofs of His omnipotence, in order to convince us of this truth,—that the Creator of the mind, could alone have created the matter with which the mind is associated!

CHAPTER II.

OF THE MODES OF NUTRITION ; COMPREHENDING A SKETCH OF THE ALIMENTARY APPARATUS ; AND OF ALIMENTARY SUBSTANCES IN PLANTS, AND IN ANIMALS.

THE subsistence of all organized beings is derived from sources external to themselves. Their means of subsistence, however, as well as the modes in which the aliments are applied, exhibit an almost endless variety. As might be expected, the widest differences, both in the nature of the alimentary substances, and in the manner of their introduction, are between plants and animals. We shall, therefore, consider the subject of nutrition under these two heads.

SECTION I.

Of the Modes of the Nutrition of Plants ; and of the Nature of those Matters by which their Nutrition is effected.

A MINUTE investigation of the anatomy and the physiology of plants would be quite foreign from the object of this treatise. At the same time, it is necessary that the reader should have some insight into these departments of knowledge, in order that he may be enabled to understand the collateral researches which it is our duty to illustrate.

“ If we reflect upon the phenomena of vegetation,” says Professor Lindley, “ our minds can scarcely fail to be deeply impressed with admiration at the perfect simplicity, and, at the same time, faultless skill, with which all the machinery is contrived, upon which vegetable life depends. A few forms of tissue interwoven horizontally and perpendicularly constitute a *stem* ; the development, by the first shoot that the seed produces, of buds which grow upon the same plan as the first shoot itself, and a constant succession of the same pheno-

menon, causes an increase in the length and breadth of the plant; an expansion of the bark into a *leaf*, within which ramify veins proceeding from the seat of nutritive matter in the new shoot, the provision of air passages in its substance, and of evaporating pores on its surface, enables the crude fluid sent from the roots to be elaborated and digested until it becomes the *peculiar secretion* of the species: the contraction of the branch and its leaves forms a *flower*; the disintegration of the internal tissue of a *petal* forms an *anther*; the folding inwards of a leaf is sufficient to constitute a *pistillum*; and finally, the gorging of the pistillum with fluid which it cannot part with, causes the production of a *fruit*.*

The "crude fluid sent up from the roots" of plants, or their *sap*, as it is termed, is found to consist of water, mucilage, and sugar, with some minute portions of other matters, generally saline. Though, under certain circumstances, moisture be absorbed by the leaves of all plants, yet there is no doubt that a great part of their nourishment enters by their roots; not, however, by the whole root indiscriminately: the nourishment of plants is taken up chiefly by the minute fibrous parts termed *spongioles*. Hence, these minute fibrous parts are of the utmost importance in the vegetable economy, and ought to be carefully preserved in transplantation, otherwise the plant will certainly perish. In some instances, roots appear to be intended to act as reservoirs of nourishment for the support of the plants of the succeeding year, on their first development. There are such roots in the *Orchis* and *Dahlia* tribes, and in others. Of late it seems to have been satisfactorily established, that the roots of all plants, besides imbibing nourishment, perform also an excretory office; and that in the soil in which plants grow, there are deposited by the roots, certain matters of an excrementitious nature, injurious to the plants from which they have been separated; and which therefore, cannot be absorbed again, till they have undergone decomposition. Such excreted matters have been adduced as the reason, why a soil becomes so much deteriorated by any one species of plant having long grown in it, that it will not support other individuals of the same species: whence the necessity of a rotation of crops.

The principal ingredient in the sap of plants, as already observed, is water. The quantity of sap in some plants, is almost incredible; and not less so, is the force with which, on the approach of warm weather in our climates, and at the commencement of the rainy season within the tropics, that sap is determined upwards. The general composition of the sap varies considerably in different parts of the same plant. For instance, sap taken from the roots is little more than water; while the quantity of saccharine and other matters contained in the sap, increases in its progress along the stem to the higher parts of the plant. When the sap begins to rise, the leaves at the same time

* Introduction to Botany, p. 216.

begin to be developed. From the leaves principally the watery portions of the sap are evaporated; and the evaporation is copious and unceasing. The more solid matters thus remain dissolved in a less proportion of water; and after undergoing further changes, as is supposed, in the leaves chiefly, these matters are returned, along with the remaining water, to be deposited in other parts of the plant, for its future uses. It seems now to be generally admitted, that one part of the food of plants is the matter extracted from the soil; and that this matter is taken up with the watery portion of the sap above-mentioned. It seems also to be admitted, that carbonic acid gas is in some way indispensable to vegetation; "for it has been ascertained, that feed plants as you will, they will neither grow nor live, whether you offer them oxygen, hydrogen, azote, or any other gaseous or fluid principle, unless carbonic acid is present." Like the other nutritious matters, this carbonic acid is partly taken up by the roots; but under certain circumstances, it is also separated from the air, and absorbed by the leaves. The circumstances under which this absorption, or rather decomposition, of carbonic acid, by the leaves takes place, are most curious and important. They are understood to be as follows:

During the day, and particularly during sunshine, the leaves of plants have the power of abstracting the carbonic acid from the atmosphere. The carbon of the acid, and perhaps also a little of its oxygen combine with the plant; while the greater part of the oxygen remains, and is diffused through the atmosphere in a gaseous state. During the night, on the contrary, or in the shade, plants, in general, convert a portion of the oxygen of the atmosphere into carbonic acid; but the quantity thus converted, is less than that separated from the carbonic acid which they decompose, under the influence of the solar light. At the same time with this formation of carbonic acid by plants during the night, they are said also to absorb from the atmosphere a certain portion of oxygen; to replace that which had been given off, during exposure to sunshine, on the preceding day. Plants absorb carbon as long as they are exposed to the light; during the season, therefore, when the day is long and the night is short, plants give off much less carbon than they absorb. This excess of the absorption of carbon, is probably one reason why in the Polar latitudes, the progress of vegetation is so rapid. By a beautiful provision of nature, in the course of the short summer of a few weeks, but of unvarying light, plants, in these latitudes, go through all the changes which in hotter climates require many months.

These phenomena of gaseous absorption and secretion in the leaves of plants, seem to be produced by a portion of the leaf peculiarly organized, and situated immediately under its external covering or epidermis. Professor Burnet has lately explained these phenomena, by referring them to the respiration and digestion of plants. The process of respiration in plants, is supposed to be continual; and to

be accompanied, as in animals, by the formation and emission of carbonic acid gas. While digestion, which consists in the decomposition of carbonic acid gas, takes place only during the exposure of plants to the influence of the light—the carbon of the carbonic acid being separated from the oxygen, and absorbed. Hence a plant exposed to sunshine purifies the air, by digesting the carbonic acid, the carbon of which it appropriates; while it sets the oxygen free. In the dark, on the contrary, digestion ceases, but respiration continues; and carbonic acid gas is thus accumulated in the surrounding atmosphere.

With respect to the “peculiar principles of plants,” these are as numerous as the individual plants themselves; so that to attempt any detailed account of them here, would be quite impracticable. Generally speaking, the peculiar principles found in plants may be divided into three great classes:—those vegetable principles in which hydrogen and oxygen are combined in the proportions that form water; as in the division of *saccharine* bodies, described in a former chapter:—those principles in which hydrogen, or rather carbon and hydrogen, predominate; which generally have more or less of an *oily* character;—and those principles in which oxygen predominates; which have usually an *acid* character. Besides these three great classes of vegetable principles, there are some that contain azote, and perhaps other elements; many of which principles also exhibit weak alkaline powers: such are the peculiar principles of Opium and other Narcotics; also of Cinchona; and a variety of others, chiefly employed as medicinal agents.

SECTION II.

Of the modes of Nutrition in Animals; and of the Alimentary Substances by which they are nourished.

To beings, like animals, endowed with locomotive powers, the absorption of their nourishment from without, would have been exceedingly inconvenient. Animals have, therefore, been furnished with an additional receptacle and apparatus subservient to nutrition, into which, as inclination or circumstances may prompt them, their food is conveyed at intervals; and from which, after having undergone certain changes, the food is absorbed and distributed over their system, as the exigences of that system may require. Hence the distinction between plants and animals;—plants absorb their nourishment by *external*, animals by *internal*, roots or *spongiolæ*. We need scarcely remark, that the stomach and alimentary canal, with their appendages, are the internal apparatus to which we allude; and that this internal apparatus constitutes a marked difference between plants and animals.

1. *Of the Organs of Digestion in Animals.*—Among the different tribes of animals, there is an almost endless diversity in the formation of the alimentary organs; and as these organs vary, not only in their own formation, but also with respect to the auxiliary apparatus, and appendages of every kind, connected with them; any detailed account of the alimentary system would at present be quite uncalled for. In general, the alimentary canal of the higher classes of animals, consists of a tube of greater or less elongation; expanded in some parts of its length; terminated at one extremity by a mouth, into which the food is received; and at the other, by a provision for the removal of excrementitious matters. In some of the less perfect animals, the alimentary canal has only one aperture; in these animals, of course, instead of a canal, there is a kind of sac. In a very few other animals, the alimentary cavity has numerous apertures. In all instances, however, and whatever may be the nature of the alimentary matters, these matters, after having been retained for some time in the organs appropriated to nutrition, are reduced, more or less, to a fluid state—are DIGESTED, in the common sense of the term, and are converted into what is denominated *chyme*. The more nutritious parts of the fluid chyme, or the *chyle* as they are termed, are then absorbed, and distributed through the system for the reparation of the animal; while the insoluble and other matters, are separated as excrementitious.

We have already alluded to the endless diversity observable in the form and arrangements of the alimentary canal in the different kinds of animals. A few of the most remarkable of these diversities among the more perfect animals will be noticed, in the outline we are now to give of the alimentary canal as existing in the human body.

Of the Mouth and its Appendages.—“In no apparatus put together by art,” says Paley, “do I know such multifarious uses so aptly contrived as in the natural organization of the human mouth.” “In this small cavity we have teeth of different shape,—first for cutting, secondly for grinding; muscles most artificially disposed for carrying on the compound motion of the lower jaw, half lateral and half vertical, by which the mill is worked; fountains of saliva springing up in different parts of the cavity for the moistening of the food, while the mastication is going on; glands to feed the fountains; a muscular construction of a very peculiar kind in the back part of the cavity, for the guiding of the prepared aliment into its passage towards the stomach, and in many cases for carrying it along that passage.” “In the mean time, and within the same cavity, is going on another business altogether different from what is here described—that of respiration and of speech. In addition, therefore, to all that has been mentioned, we have a passage opened from this cavity to the lungs, for the admission of air, exclusively of every other substance; we have muscles, some in the larynx, and without num-

ber in the tongue, for the purpose of modulating that air in its passage, with a variety, a compass, and a precision of which no other musical instrument is capable. And lastly, we have a specific contrivance for dividing the pneumatic part from the mechanical, and for preventing one set of actions interfering with the other." "The mouth, with all these intentions to serve, is a single cavity; is one machine, with its parts neither crowded nor confined, and each unembarrassed by the rest."* Such is Paley's graphic description of the human mouth and its appendages: we have quoted it at length, that it may serve as a text for illustration.

Man has been observed to differ more from other animals in the form of his *lower jaw*, than in the form of any other bone of his body. This difference consists chiefly in the prominence of the chin; that peculiar characteristic of the human countenance, which distinguishes more or less every race of mankind, and is found in no other animal whatever. There is likewise a striking difference, among the various tribes of animals, in the mode of articulation of the lower jaw; which in all cases is singularly adapted to the nature of the food of the animal. Thus, in the carnivorous tribes, the articulation is so arranged that the jaw can move only up and down; and is almost entirely incapable of that lateral movement, which is essential to genuine mastication. Hence such animals cut and tear their food, and swallow it in large pieces. But those animals that live on vegetables, in addition to the vertical motion of their lower jaw, have the power of moving it backwards and forwards, or to either side, so as to produce a grinding effect, admirably fitted for triturating the vegetable matters on which they subsist.

The *teeth* next claim our attention, as being not less suited to the habits of the animal, than in the form of the jaw in which they are set. Teeth are divided by naturalists into three orders:—The *Incisores*, or *cutting teeth*, placed in the front part of the mouth; the *Cuspidati*, *canine*, or *corner teeth*, usually placed near the angles of the jaw; the *Molares*, *grinding*, or *lateral teeth*, which always occupy the sides and back part of the jaw. In man, and in those animals which most nearly resemble him in their structure, teeth exist of all the above varieties of form. But many species want one or other of these varieties; while the teeth they possess, are of a form and size very unlike the same teeth in man. Thus, in animals which live chiefly on the harder vegetable substances, and which, from their peculiar mode of feeding, have been termed *gnawing* animals, the *incisor* teeth are the most remarkably developed; as these teeth are the best adapted, and indeed are the most necessary, to their habits. In *carnivorous* animals, on the other hand, the *canine* teeth are of chief importance; as enabling these animals to seize and hold their prey; in such animals, accordingly, the canine teeth are the most perfectly formed.

* Natural Theology, chap. ix.

Lastly, in the animals that feed on grass, and other *herbaceous* substances, and whose aliments require long and complete mastication, the *Molares*, or grinding teeth, attain the greatest enlargement; and in many of these animals the incisor and the canine teeth are entirely wanting. Besides the adaptation of the form, the enamel or harder cutting portion of the teeth, is distributed over and throughout their texture, according to their intended uses, in a manner that is truly extraordinary. The description however of the arrangement of the enamel, as well indeed as a minute account of the teeth themselves, belong to the physiologist, on whose province we shall not further intrude. But it is impossible to take even the most superficial view of the teeth of animals, without being struck with the admirable design and fitness they display, throughout their whole fabrication.

The next auxiliary appendages of the mouth are the *glands* that secrete the saliva; in which we observe the same beautiful arrangement as in the form and structure of the teeth. In man, though the apparatus for the secretion of the saliva, is by no means of large size, yet the quantity of fluid which the salivary glands are capable of secreting, and do secrete during mastication, is very considerable; often amounting, it is said, to half a pint or more. This fluid in its perfectly healthy state, is neither acid nor alkaline, or alkaline only in a slight degree; but occasionally it assumes an acid character. Besides the great utility of the saliva in moistening the food, we cannot doubt that it assists, and is even necessary to the full completion of the succeeding digestive process. By a beautiful arrangement, those animals that do not masticate their food, as the carnivorous tribes, have very small salivary glands; while in animals whose food requires long mastication, as in ruminating animals—the cow and the sheep, for example, the salivary glands are very large.

The passage by which the masticated food is conveyed from the mouth to the stomach is termed the *œsophagus*. Like the whole frame, the *œsophagus* is admirably adapted for its office; and in different animals, varies in size and structure, according to their habits. These differences, however, scarcely concern us at present, and we pass on to that important organ—the Stomach.

The human *stomach* is a membranous bag, of a shape rather difficult to be described, so as to convey a clear notion of it to the reader. If we imagine two cones united at their bases, and the figure thus produced to be bent into a semicircular form, some idea may be obtained of the outline of the stomach in the human species. In respect to its size, the human stomach varies; but in the adult, its capacity is usually such as to contain about two or three pints. The stomach is situated immediately under the diaphragm; but the precise place of the organ differs somewhat with its state of repletion. The general position of the stomach is transverse, or horizontal, supposing the body to be upright; the left orifice, or *cardia*,

which communicates with the œsophagus, being somewhat higher than the right orifice, the *pylorus*, through which the food is transmitted to the further portion of the alimentary canal. The upper space between the two orifices is usually termed the small curvature; the lower space, the great curvature, of the stomach. Numerous glands occupy the internal surface of the stomach, particularly near its pyloric orifice. By these glands a fluid is secreted of the highest importance in the digestive functions, on the nature of which we shall enlarge hereafter.

Such is the stomach of man; but the form and the magnitude of this organ vary almost infinitely in different animals, according to the nature of their food, and other circumstances. We can, at present, notice only two or three of the most remarkable diversities. In most carnivorous animals, the stomach bears a resemblance to that of man. There is also a resemblance, at least externally, in certain herbivorous animals; as in the horse, the rabbit, and others. The internal arrangements, however, are different; thus, in the animals above mentioned, the left or cardiac half of the stomach is lined with cuticle; while the other half, towards the pylorus, has the usual villous and secreting surface. Hence, these two portions of the stomach perform very different offices, and generally contain food in very different states of reduction. The most complicated and artificial arrangement, however, both with respect to the structure of the parts, and the lining membranes, is found in the well-known four stomachs of the animals that ruminate and have divided hoofs; as the cow and the sheep. We shall endeavour to give a general description of these four stomachs. The first stomach is denominated the *Paunch*, and in the adult animal is by far the largest. The second stomach follows, and may be regarded as a globular appendage to the paunch; from which it is distinguished, principally, by the regular and beautiful distribution of its internal membrane into polygonal cells. The third stomach is the smallest of the four, and is the most remarkable in its structure: its capacity is much diminished by numerous and broad duplicatures of its internal membrane, which are placed lengthwise, and vary in breadth in a regular order. The fourth stomach is next in size to the paunch, and is lined with a villous membrane approaching to that of the human stomach, which this fourth stomach may be supposed to represent; the three preceding stomachs having been evidently intended to prepare the refractory food of the animal for the true digestive process, which it undergoes in this last stomach. Every one is acquainted with the fact that animals furnished with the gastric arrangements above described, *ruminate*; that is to say, have the faculty of masticating a second time, and at their leisure, that food which had been hastily swallowed, and deposited in their first stomach. The contrivance by which rumination is effected is very beautiful; and is connected with the peculiar arrangement already

mentioned of the four stomachs, with respect to the œsophagus: but, as it would not be easy in a few words, to give more than a general outline; we must refer the reader to anatomical works, for a more particular description of the stomachs of ruminating animals. The only other modification of the stomach which we shall notice, is that which exists in some birds; as for example, in the common fowl. The common domestic fowl, as well as many similar birds, has a sort of preliminary stomach, termed the *crop*, formed by an expansion of the œsophagus. In the crop, the hard seeds, and other compact substances which birds devour, are macerated and softened, and perhaps undergo further changes, before they enter the proper stomach, to be next considered. The proper stomach, or *gizzard*, of birds, is a hollow muscle of great strength, lined with a firm and thick epidermis, disposed in rugæ, and admirably adapted for triturating the hard matters that constitute their food. The small stones which these birds constantly swallow seem also to promote this trituration.

We have given the above short sketch of the structure of the stomachs of animals, not only that we might impart to the general reader a faint conception of the extraordinary design manifested in that structure; but to enable us to show the object of diversity of structure, when we come to speak of the function of digestion a little more in detail.

After the stomach we proceed to the consideration of the *Intestinal Canal*. In man, and in the more perfect animals, this canal assumes two well marked forms, usually termed, from their relative size, the small and the large intestines. In most animals resembling man, the small intestines are the longest, and their internal surface is villous. The coats of the large intestines are thicker, and the membrane with which they are lined is very rarely villous. The first portion of the small intestines, from its supposed length termed the *duodenum*, or twelve-inch intestine, begins from the pyloric orifice of the stomach; and, in many animals, has a course not easy to be described, so as to be intelligible to the general reader. The duodenum terminates in the second portion of the small intestines, called the *jejunum*, from its being usually empty. The duodenum differs from the stomach and other parts of the canal, in being secured in its position by various attachments; while the stomach and other parts of the canal, are comparatively loose and floating. This fixedness appears to serve many wise purposes, on which we cannot dwell here; but one purpose probably is, to ensure the easy and regular passage of the bile and the pancreatic fluids into this part of the canal. As the organs producing these important fluids are fixed, the conducting tubes necessarily require also to be connected with a fixed organ; otherwise the passage of the fluids from the secreting organs to the intestine, would be constantly liable to interruption. The duodenum is very highly organized, and its functions are pro-

bably not less important than even those of the stomach. The remainder of the small intestines is divided into the *jejunum* already mentioned, and the *ilium*; but the precise place where one ends, and the other begins, is scarcely definable; nor are the differences of structure between the two so obvious, as to require to be noticed in this place.

The large intestines exceed the small intestines in diameter, but are considerably shorter: their form and structure are also different. The first division of this portion of the alimentary canal is termed the *cæcum*; and, in a man at least, may be considered as little more than the head or commencement of the next division of the large intestines, termed the *colon*. The colon is of much greater diameter than any other part of the intestinal canal, and constitutes almost the entire length of the large intestines. The colon begins low down on the right side of the abdomen, then ascending to the level of the stomach, passes across to the left side, immediately below that organ. On the left side, the colon descends again, and at the same time forms what is called the *sigmoid flexure*. The colon and the alimentary canal at length terminate in what is named the *rectum*. The texture of the colon is much thicker than that of any other portion of the canal. Its organization also is peculiar; and, like the whole arrangement, wonderfully adapted for the purposes which this portion of the canal is supposed to serve in the animal economy.

Such is the short account of the alimentary canal in man. We shall now state some of the more remarkable diversities that are observed in the lower animals.

One of the most striking circumstances relative to the alimentary canal in animals, is its various lengths in the different classes. In man, and other omnivorous animals, the proportion is intermediate between that of carnivorous animals on the one hand, and herbivorous animals on the other. In man, the whole length of the canal is about six or seven times that of the body; while in carnivorous animals it is only from about three to five times that length; and in graminivorous animals, as in the sheep, the length of the canal is twenty-seven times that of the body. In other herbivorous animals, the length of the canal varies from twelve to sixteen times that of the body. In most birds the alimentary canal is much shorter than in quadrupeds; the length in general, being between twice and five times that of their bodies: while in many reptiles and fish, the length of the canal scarcely exceeds that of the body: in some fish it is even less; as for example, in the shark. There are animals that feed on vegetables, the length of whose alimentary canal is not so great, as in the instance above stated; the deficiency in length being apparently made up in breadth. Thus, in the horse, the stomach is simple, and not much developed, when compared with the size of the animal; nor are the intestines very remarkable for their length; but the *cæcum* and the large intestines are enormously expanded in

diameter. The cœcum of the horse seems to perform many of the offices of a second stomach, and is of fully equal capacity. There are in animals, many other beautiful arrangements of the digestive organs, which we shall pass without further notice; as our desire is to inform the reader of the general connexion and adaptation, which exists between the structure of animals, and the food on which they live. It remains to conclude this outline of the digestive organs, with a few remarks on those almost invariable accompaniments of the alimentary canal,—the *liver*, the *pancreas*, and the *spleen*.

The liver is the largest glandular apparatus in the body, and one of its important offices is to secrete the *Bile*; which secretion, as before observed, enters the intestines, near the commencement of the duodenum. The general situation of the human liver, is in the upper part of the abdomen, under the ribs on the right side; from whence it extends more or less to the region of the stomach, and in some instances, even to the left side. The appearance and form of the liver, are too well known to require description here; while to those who are unacquainted with these particulars, they cannot be adequately made known by words. In man, and the greater number of animals, the bile is collected in a small bag, termed from its office, the *gall-bladder*. The animals wanting a gall-bladder are chiefly vegetable feeders; as the horse and the goat among quadrupeds, the pigeon and the parrot among birds. On the contrary, most amphibia have a gall-bladder; but it exists in few animals lower in the zoological scale. The liver assumes a variety of forms in different animals. In many, and particularly in carnivorous, animals, the liver is more divided than in man: while in ruminating animals, also in the horse, the hog, and others, its divisions are not more numerous than in man. The liver of birds consists of two lobes of equal size.

The *pancreas*, or *sweetbread*, is a large gland, which, in the human body, lies across the upper and back part of the abdomen, behind the stomach; and between the liver and the spleen. The pancreas is composed of numerous small glands, whose ducts unite and form the pancreatic duct. In man the pancreatic duct joins the gall duct, at its entrance into the duodenum, and thus the peculiar secretion of the pancreas is poured into that intestine, commingled with the bile. In animals the pancreas, like the liver, is much varied in its form; and its duct, instead of entering with the biliary duct, often joins the intestinal canal separately; as in the hare and others. In fishes the pancreas is wanting; but what are termed the cœcal appendages, are supposed to have a similar office. The nature of the pancreatic fluid will be considered presently.

The *spleen* in man is situated in the upper and left side of the abdomen. Its shape is oblong, and its colour a deep mulberry; more nearly resembling that of the liver than of any other organ. The spleen has no excretory duct, and its use is very little understood.

Among the less perfect animals, the spleen is much smaller than in those whose structure resembles that of man: and where there is more than one stomach, the spleen is always attached to the first. The situation also of the spleen varies in the less perfect animals; thus in the frog, it is fixed in the mesentery.

We proceed to notice, very briefly, the peculiar circulation of the blood in the abdominal viscera; together with the character and agency of that portion of the nervous system, which is connected with the digestive and assimilating functions of animals.

In the general circulation of the blood through an animal body; a large tube or artery, communicating with the heart, is gradually subdivided as it is prolonged from that organ, till its subdivisions finally become imperceptible. While in this state of minute subdivision, the arteries assume the character of veins. The change the veins undergo in their progress, is the reverse of that of the arteries. They unite gradually, and, at length, form one or two principal tubes, which proceed to the side of the heart opposite to that from which the artery originated. Such is the circulation of the blood through the body generally; the circulation through the lungs is merely a repetition of the same arrangement. Throughout the body, therefore, the general motion of the blood in arteries is from greater to smaller tubes; while in the veins it is from smaller to greater tubes. By a beautiful provision, the veins are also furnished with valves, which most effectually prevent the regurgitation of the blood: without such valves, the blood could scarcely flow in a regular stream. We have introduced these remarks, with the view of stating, that the circulation of the blood through the organs of digestion, presents a remarkable exception to the general circulation of the body. The venous blood, from these organs, undergoes a preliminary arterializing process in the liver, before it is remingled with the venous blood from the rest of the body. That is to say, the veins from the organs of digestion, unite into one large vessel termed the *vena portæ*; which, entering the liver, is there again subdivided, in the same manner as an artery. These ultimate subdivisions of the *vena portæ*, together with the similar subdivisions of the proper artery of the liver, coalesce; and from the blood thus mixed the bile is separated. The coalesced blood-vessels assuming the character of veins, then gradually unite, and at length form two or three large tubes, which empty themselves into the general veins going to the heart; while the hepatic ducts, uniting in like manner, convey the bile to the gall-bladder. Such are the principal facts connected with the circulation of the blood in the abdominal viscera, and with the secretion of the bile. We shall soon have occasion to bring them to the recollection of the reader.

When speaking of organic agents, we noticed the probability of the opinion, that in living beings, there exists a series of agencies gradually raised one above another; each agency having more or

less control over all those below it. Now, in the digestive and assimilating functions, we appear to have, as we might expect, the lowest of these agencies. The agencies operating in digestion, and in the first stages of assimilation are, in man, perhaps the same that exist in all organized beings, vegetable as well as animal; and are only a few degrees, as it were, above the agencies of mere inorganic matter. This resemblance is inferred from the phenomena of assimilation; not less than from the peculiar character of the nerves, distributed over the digestive organs; the effects of which nerves, as we shall presently endeavour to show, approach more nearly to those of common chemical agents, than to the effects of any agent belonging to the animal economy. These nerves compose what, from their peculiar structure, are termed the *ganglionic nerves*. In animals of the very lowest kind, the ganglionic nerves alone appear to exist; and though in the more perfect animals, these nerves are connected with others of a higher character, they always form, by themselves, a peculiar system; the functions of which seem to be of the subordinate character above noticed.

2. *Of Alimentary Substances*.—It may be considered as a general rule, that organized beings adopt, as aliments, substances lower than themselves in the scale of organization; or which, if not originally lower, in some measure become so, by certain spontaneous changes they undergo. There are, of course, innumerable exceptions to this rule; but viewing the whole of animated beings, it seems to be a law of nature. Thus plants, and perhaps the very lowest kinds of animals, have the power of assimilating carbonic acid gas: the powers of assimilation of plants, and of such animals, may also extend to other inorganic compounds of carbon—indeed they seem to derive their chief nourishment from matters of that nature. Higher in the zoological scale, we find that animals almost invariably prey on those that are inferior to themselves, either in magnitude, in organization, or in intelligence; till we arrive at man himself. He, as his necessities, or as his fancies may dictate, appropriates every nourishing substance, even carbonic acid gas; which his stomach, perhaps in common with that of all animals, seems to have the power of assimilating. Of course a lion, or even a crab, can feed on the body of a man, as well as on that of an ox or of an insect. But no one we presume, will assert, that man is the natural prey or food of these animals; and that alone is the degree of immunity, for which we here contend: for in all the operations of nature, we must try to discover and bear in mind, not the exception, but the rule; otherwise we shall be constantly liable to error.

By this beautiful arrangement in the mode of their nutrition, the more perfect animals are exonerated from the toil of the initial assimilation of the materials composing their frame; as in their food, the elements are already in the order which is adapted for their pur-

pose. Hence the assimilating organs do not require that complication, which they otherwise would have needed; and much elaborate organization is saved. Striking illustrations of this abridgment of organization, are afforded by the differences before mentioned, between the assimilating apparatus of carnivorous and of gramivorous animals. According to the scale which this difference exhibits, we can form some conception of the complication that would be requisite, if such an animal as man were, like a plant, destined to feed on carbonic acid gas; or carburetted hydrogen; or any other simple compound of carbon.

Another great purpose is affected by this arrangement, without which, organization, at least, as at present constituted, could hardly exist. If organized beings did not prey on each other, their remains would, in time, accumulate in such quantity, as to be nearly incompatible with life; certainly with animal life in its most perfect condition, as it is at present known to us. But by the arrangement that animals are food to each other, not only is an opportunity afforded, for the existence of a greater number of animals, and of a greater variety among them; but the obtrusion of the bodies of animals, in whom life has become extinct, is entirely prevented: nor, is the removal of the dead animal matter the only good accomplished, but many other important results are obtained. To enter upon the consideration of these, would be foreign to our present object: there is, however, one consequence of this system of universal voracity, which more immediately concerns us, since it is of a nature so comprehensive, as to suggest a natural classification of alimentary substances; we allude to the similarity of composition among the staminal principles which constitute the fabric of organized beings.

In our introductory remarks on the chemistry of organization, we showed that organized matters, however apparently dissimilar, yet, chemically speaking, are often nearly related. Of this relation we gave as an example, the composition of the extensive class of substances, denominated the *saccharine group*; all of which, notwithstanding the endless diversity of their appearance, we showed to be essentially alike in their composition, and to consist of carbon associated with water. Saccharine substances are chiefly found in the vegetable kingdom, of which they form the characteristic staminal principle.

Another well known class of bodies, existing both in vegetables and in animals, are those whose character is *oily*. Oleaginous bodies occur in an infinite variety of forms, some being solid, others fluid; yet, in every instance, their peculiar properties are so strongly marked, that we seldom hesitate about their nature. In this distinctness of outward appearance, oily bodies are strongly contrasted with the saccharine group before mentioned; many of which have few *apparent* and sensible properties in common. The composition of all

bodies of this oleaginous group, which we have hitherto had an opportunity of examining in a satisfactory manner, we have found to be essentially the same: they are either composed of olefiant gas and water, or have a reference to that composition. Such is also the composition of the well known proximate principle termed *spirit of wine*, or *alcohol*; into which, most substances belonging to the saccharine group, under favourable circumstances, are readily convertible by the process termed fermentation.

When almost any part of an animal body, (with the exception perhaps of those matters of a purely oleaginous character) is boiled in water, it is separated into two portions,—one soluble in water, and forming with the water a tremulous jelly, or *gelatine*—the other remaining insoluble, indeed becoming harder, the longer it is boiled; and which, from the identity of its properties to those of the white of an egg, is denominated *albumen*. These animal principles exist in very different proportions in the different textures; some of these textures, as the skin, being convertible almost entirely into *gelatine*; while others yield comparatively little *gelatine*, and consist principally of *albumen*. In no animal compound does *gelatine* exist as a fluid; hence, it has been supposed to be produced by boiling; but the supposition does not appear to be well founded. One of the most remarkable properties of *gelatine*, is, its ready convertibility into a sort of sugar, by a process similar to that by which starch may be so converted. *Gelatine* may be considered as the least perfect kind of albuminous matter existing in animal bodies; intermediate, as it were, between the saccharine principle of plants, and thoroughly developed *albumen*: indeed, *gelatine* in animals, may be said to be the counter-part of the saccharine principle in vegetables. *Albumen* exists in the fluid state as a component of the blood: small quantities of fluid *albumen* are also contained in certain animal secretions: but there is much more of the principle in a solid state; forming what is termed *coagulated albumen*. The blood likewise contains *Fibrin*, another modification of the albuminous principle, in a fluid, or at least in a suspended state: though the most frequent condition of *Fibrin*, is that of a tough fibrous mass, in which condition, together with *albumen*, it forms the basis of the muscular or fleshy parts of animals. The *curd* of milk is also a modification of the albuminous principle. Another modification of the same principle is the substance called *gluten*; this substance though most abundant in vegetables, so far resembles the fleshy parts of animals, as to be, in like manner, capable of separation into two portions, analogous to *gelatine* and *albumen*. Neither of these modifications of *albumen* exhibits the quality possessed by *gelatine*, of being artificially convertible into saccharine matter; at least by any known process: but all of them, including *gelatine*, differ from the oleaginous and the saccharine principles, in this respect; that they contain a fourth ele-

mentary principle, namely, azote. The exact composition of the albuminous group cannot at present be stated.

Such are the *three great staminal principles* from which all organized bodies are essentially constituted. Of these staminal principles it has already been remarked, that, without changing their essential composition, they are capable of assuming an infinite variety of modified forms; many of which are so peculiar, that it is very difficult to recognise their identity, from their sensible properties. Moreover, these staminal principles, in their forms, are capable of readily passing into one another, and of combining with each other; at least the organic agents, as we shall see hereafter, have the power of effecting these changes. Further, these staminal principles are all susceptible of transmutation into new principles, according to certain laws: thus the saccharine principle is readily convertible into the acid, termed oxalic; or, under other circumstances, into the modification of the oleaginous principle, alcohol. Though an endless variety, however, of these modifications of the staminal principles exist in different organized beings, accompanied by numerous foreign bodies, the proportion they bear to the staminal principles is very limited; and they are either confined to glandular secretions, or are excrementitious, or extravascular: that is to say, these modifications and combinations form no part of the living animal, though they are attached to it; as in the case of the various products of secretion, the shells of the molluscous tribes, and many others.

The consequence then, to which we before alluded is; that as all the more perfect organized beings feed on other organized beings, *their food must necessarily consist of one or more of the above three staminal principles*. Hence, it not only follows, as before observed, that in the more perfect animals, all the antecedent labour of preparing these compounds *de novo*, is avoided; but that a diet to be complete, must contain more or less of all the three staminal principles. Such, at least, must be the diet of the higher classes of animals, and especially of man. It cannot indeed be doubted, that many animals have the power of forming a chyle, and if expressly organized for the purpose, may even live for a while on one of these classes of aliments; but that they can be so nourished for an unlimited time, is exceedingly improbable. Nay, if we judge from what is known from universal observation, as well as from experiments which have been actually made by physiologists regarding food, we are led to the directly opposite conclusion; namely, that the more perfect animals could not so exist; but that a mixture, of two at least, if not of all the three classes of staminal principles, is necessary to form an alimentary compound well-adapted to their use.

This view of the nature of aliments is singularly illustrated and maintained by the familiar instance of the composition of *Milk*. All other matters appropriated by animals as food, exist for themselves; or for the use of the vegetable or animal of which they form a con-

stituent part. But milk is designed and prepared by nature expressly as food; and it is the *only material* throughout the range of organization that is so prepared. In milk, therefore, we should expect to find a model of what an elementary substance ought to be—a kind of prototype, as it were, of nutritious materials in general. Now, every sort of milk that is known, is a mixture of the three staminal principles we have described; that is to say, milk always contains a *saccharine* principle, a *butyraceous* or *oily* principle, and a *caseous*, or strictly speaking, an *albuminous principle*. Though in the milk of different animals, these three staminal principles exist in endlessly modified forms, and in very different proportions; yet neither of the three is at present known to be entirely wanting in the milk of any animal.

Of all the evidences of design in the whole order of nature, Milk affords one of the most unequivocal. No one can for a moment doubt the object for which this valuable fluid is prepared. No one can doubt that the apparatus by which milk is secreted has been formed especially for its secretion. No one will maintain that the apparatus for the secretion of milk arose from the wishes or the wants of the animal possessing it, or from any fancied plastic energy. On the contrary, the rudiments of the apparatus for the secretion of milk must have actually existed in the body of the animal, ready for developement, before it could have felt either wants or desires. In short, it is manifest that the apparatus and its uses, were designed and made what they are, by the great Creator of the universe; and on no other supposition, can their existence be explained.

The composition of the substances, by which animals are usually nourished, favours the mixture of the primary staminal alimentary principles; since most of these substances are compounds, of at least two, of the staminal principles. Thus, most of the gramineous and herbaceous matters contain the saccharine and the glutinous principles; while every part of an animal contains at least albumen and oil. Perhaps, therefore, it is impossible to name a substance constituting the food of the more perfect animals, which is not essentially a natural compound of at least two, if not of all the three great principles of aliment. But it is in the artificial food of man that we see this great principle of mixture most strongly exemplified. He, dissatisfied with the spontaneous productions of nature, culls from every source; and by the force of his reason, or rather of his instinct, forms in every possible manner, and under every disguise, the same great alimentary compound. This after all his cooking and his art, how much soever he may be disinclined to believe it, is the sole object of his labour; and the more nearly his results approach to this object, the more nearly do they approach perfection. Even in the utmost refinements of his luxury, and in his choicest delicacies, the same great principle is attended to; and his sugar and flour, his eggs and butter, in all their various forms and combinations, are nothing more or less, than disguised imitations of the great alimentary prototype MILK, as furnished to him by nature.

CHAPTER III.

OF THE DIGESTIVE PROCESS ; AND OF THE GENERAL ACTION OF THE
STOMACH AND DUODENUM.

WE proceed now to consider the most important function of the stomach, by which the assimilation of the food is begun. But before that function can be well understood, it is necessary to make a few remarks on the influence of water, in modifying the intimate constitution and the peculiar properties of alimentary substances. We have intentionally delayed these remarks, in order that in this place the chemical influence of water might be more strikingly exemplified.

Water enters into the composition of most organized bodies in two separate forms ; which must be clearly distinguished, and which it is requisite that the reader should always bear in mind. Water may constitute an *essential* element of a substance, as of sugar or of starch in their dryest states ; in which case, the water cannot be disunited without destroying the compound : or water may constitute an *accidental* ingredient of a substance, as of sugar or of starch in their moist states ; in which case more or less of the water may frequently be removed, without destroying the essential properties of the compound. Now, a very large number of organized bodies, (perhaps all those to which our present inquiry relates) contain water in both these forms ; both as an essential element, and as an accidental ingredient ; and in most instances, it is impossible to discriminate between the water that is essential, and that which is accidental. The mode of union, however, among the elements of bodies, in these two states of their combination with water, must be altogether different. Wherein the difference consists, is very imperfectly known ; but perhaps the following remarks may throw some light on the subject ; at least, they will serve to point out, the nature of these two modes of union, to the reader.

In the first part of this volume, we stated that the molecular, or combining, weights of carbon and of water are, by chemists, usually considered to be represented by the numbers 6 and 9 ; the weight of hydrogen being *one*. We also advanced the opinion, that the molecules or atoms of carbon and of water, where more than one exist, instead of remaining separate, as is now supposed, are associated together into groups, or supermolecules ; and that carbon, water, and similar bodies, always enter into combination, not as single molecules, but as one supermolecule. To illustrate our meaning, let us take as examples, the state of combination of the molecules constituting the different varieties of sugar.

Sugar from the cane, in its purest state, and when as free as possible from accidental water, is, according to the present language of

chemists, composed of 9 atoms of carbon and 8 atoms of water. Now, we suppose these 9 atoms of carbon, and 8 atoms of water, to be associated into two supermolecules, weighing (9×6) 54, and (8×9) 72, respectively. So that, we conceive a molecule of sugar from the cane to be a binary compound, of a supermolecule, of carbon weighing 54, and a supermolecule of water weighing 72. Again, the sugar of honey, according to the present language of chemists, is composed of 9 atoms of carbon, and 12 atoms of water; or, according to our view of molecular arrangement, the sugar of honey is composed of two supermolecules, one of them, carbon, weighing 54, as in the sugar of the cane—the other, water, weighing no less than (12×9) 108. A similar statement may be given of the composition of Lignin, another of the saccharine class of bodies. This substance, which, in all its various forms appears to consist essentially of equal weights of carbon and water, may be said to be composed of 9 atoms of carbon, and 6 atoms of water; or, according to our views, of two supermolecules weighing (9×6) 54, and (6×9) 54, respectively. Hence, the saccharine class of bodies may be represented in the following manner:—

Carbon.		Water.	
54	+	54	Lignin.
54	+	72	Cane Sugar ; Wheat Starch.
54	+	108	Sugar of honey ; Arrowroot.

The molecular constitution of the saccharine bodies, above stated, may be compared with that of vinegar. According to the present language of chemists, vinegar, in its purest and most detached form, is composed of 4 atoms of carbon, and 3 atoms of water; or, according to our views, of two supermolecules weighing (4×6) 24, and (3×9) 27, respectively. Thus, the molecular constitution of these two different states of vinegar may be represented as follows:—

Carbon.		Water.	
24	+	27	Absolute vinegar.
24	+	36	Crystallized or solid vinegar.

We have stated the composition of vinegar, in order to draw the attention of the reader, to the difference between the supermolecule of the carbon in that acid, and the supermolecule of the carbon in the saccharine class of bodies; a difference to which these two classes of bodies probably owe the striking differences in their sensible properties. But why the supermolecule of carbon should be 54 in bodies of the saccharine class, and why this supermolecule should in general exist in the self-attractive form, and produce sweetness: or why the supermolecule of carbon in vinegar should be 24, and why this supermolecule should have such a tendency, as it exhibits, to assume the self-repulsive form, and to produce sourness; we do not know, and probably shall never be able fully to explain. Still, there can be little doubt that a careful and philosophical examination

of the phenomena, would go far to dispel the obscurity in which the subject is now involved.

Such are the principles, which, we conceive to regulate the chemical union of organic, and indeed of all other compounds; and if chemical union be so regulated, the inferences are most curious and important. With these inferences in general, we have at present no concern: but those more particularly relating to alimentary compounds are the following:—

First. We would draw the attention of the reader to the contrast between the two supermolecules of carbon, and of water, constituting sugar; the supermolecule of carbon being uniform throughout the whole saccharine class, while the supermolecule of water is that which is variable. Now, there is reason to believe that this contrast holds in other instances; and that in different organized substances of the same kind, the supermolecule of carbon, or of some of its compounds, remains the permanent and *characteristic* element; and that the different modifications are produced by variations in the supermolecule of water; which may be called the *modifying* supermolecule.

Secondly. The manner of the operation of the modifying agency may be thus illustrated. If to a portion of cane sugar, we add that quantity of water, which, by an easy calculation, we learn is necessary to be united with it, in order to its conversion into sugar of honey; we find that we cannot succeed in producing such conversion; and that the excess of water which had been added, flies off, and leaves the cane sugar in its original state. On the other hand, if we apply heat to the sugar of honey; though we may indeed drive off part of the water essentially associated with that sugar, we do not obtain sugar similar to that of the cane; but we destroy, or altogether decompose the sugar of honey. These facts, therefore, show that the excess of water, constituting the difference of the sugar of honey from the sugar of cane, is really in some state of essential union, incapable of being imitated; while, in the cane sugar, the water may exist as an accidental ingredient only. In fact, according to our views of molecular arrangement; *every individual supermolecule of the weaker sugar contains a portion of this excess of water, as an essential element of its composition.* Hence such water cannot be separated from any compound, without destroying the entire crasis, or constitution, of its molecular elements; which, as in the case of the sugar of honey, we find, by experiment, to be the result. On the other hand, we suppose the molecules of accidental water *to form no essential element of the molecules of sugar, or of other bodies, but to be only loosely associated with them;* and hence, the ease with which accidental water may be separated without destroying such bodies.

Thirdly. It may be advanced as a general rule, that the larger the number, representing the weight of the supermolecule of any compound substance; whether such number represent the characteristic,

or the modifying supermolecule; the more easily may that compound substance be decomposed. Thus, the sugar of honey is more easily decomposed—is much less permanent, than the sugar of the cane; and the purest sugar, is much less permanent than Lignin. In like manner, when water is the modifying element of any compound, as it is in most organic compounds, the larger the number representing the supermolecule of the water, the greater, for the most part, is the solubility of the compound.

Fourthly. There are, at present, no chemical terms corresponding to those differences of composition, which we have brought under the notice of the reader. Now, the terms *strong* and *weak*, which in commerce, distinguish the different varieties of sugar, are sufficiently expressive; we have, therefore, made choice of them, to denote the similar varieties of other organic compounds. Thus, when we speak of a *strong* compound; we mean that its constituent supermolecules are, like those of strong cane sugar, less complicated than the supermolecules of a *weak* principle, like those of the sugar of honey. Again, there are no terms expressive of the conversion of a strong substance into a weak substance, or the contrary. To express such conversion we have adopted the terms *reduction*, and *completion*.

In the above illustrations of the modifying influence of water in organic compounds, we have selected sugar as our example, solely from its being the most familiar. But, as we have more than once noticed, exactly the same laws appear to regulate the composition of all organized bodies. Thus in the *strong*, fixed, and solid, oils or fats, the characteristic supermolecule of which, as we have already said, has some relation to olefiant gas; the modifying molecule of water is very small, perhaps, in some oleaginous bodies, is even a submolecule. Whereas, in alcohol, which is the *weakest* condition of the oily principle, the weight of the modifying supermolecule of water is more than half that of the olefiant gas, and alcohol is perfectly soluble in water.

Gelatinous and albuminous substances, also, exhibit precisely the same variations. The *strong* tenaceous glue, employed in the arts, is made from the firmer parts of the hides of old animals; while the gelatinous size, or weak glue, is made from the skins of younger and more delicate animals. These two varieties of glue differ from one another, in the weights of the modifying supermolecules of water which enter into their composition. In general, it may be observed, that the substances composing the frame of old and of young animals, differ chiefly in the weights of their modifying supermolecules of water; and that the dissimilarity of their properties, is chiefly owing to this difference.

If the reader has clearly apprehended, and will bear in mind, the principles that have now been stated, as regulating the chemical constitution of organized bodies, and the modes in which they are influenced by their modifying constituent, water; he will be able to

accompany us in the observations we are about to offer; and he will thus, more especially, be able to form a general conception of the *chemical* operations of the stomach. The operations of the stomach, viewed as a whole, may be stated as follows:—

1. The stomach has the power of dissolving alimentary substances, or, at least of bringing them to a semifluid state. This operation seems to be altogether chemical; and is probably effected by *reducing* the properties of these alimentary substances.

2. The stomach has, within certain limits, the power of changing into one another, the simple alimentary principles, which have been described in the last chapter. Unless the stomach possessed such a power, that uniformity in the composition of the chyle, which we may imagine to be indispensable to the existence of every animal, could not be preserved. This part of the operations of the stomach, appears, like the reducing process, to be chemical; but not so easy of accomplishment; it may be termed the *converting* operation of the stomach.

3. The stomach must have, within certain limits, the power of *organizing* and *vitalizing* the different alimentary substances; so as to render them fit for being brought into more intimate union with a living body, than the crude aliments can be supposed to be. It is impossible to imagine, that this organizing agency of the stomach can be chemical. This agency is vital, and its nature is completely unknown.

1. *Of the Reducing Powers of the Stomach.*—In order to render more intelligible that function of the stomach, which it owes to its reducing power, let us endeavour to trace the series of phenomena, which appear to arise during the conversion of simple albuminous matter into the albumen of the chyme; without taking into account any other change.

When a portion of fluid albumen, as of the white of an egg, or of milk, is introduced into the stomach of an animal, as of a dog, it instantly becomes solid; or, in ordinary language, is *coagulated*. This coagulation is probably a mere chemical change; for the same change would, under similar circumstances, take place out of the body. That is to say, if the white of an egg, or milk, were mixed with a fluid more or less acid, like that which exists in the stomachs of animals while the food is undergoing the process of digestion; it would be coagulated. There may be, however, and probably is, some object in the change produced by coagulation; since the stomachs of animals are fitted to operate chiefly on solid matters. Admitting the object of the change, we can hardly consider it to be essential to the subsequent process; for gelatine, a staminal alimentary principle, nearly resembling albumen in its composition, undergoes, under similar circumstances, no such solidifying change. The albumen thus solidified by the stomach into a mass or curd, is soon altered further; more especially that part of the mass, with which

the membrane of the stomach is in contact. The curdy mass assumes a gelatinous appearance; then each portion is successively more and more softened, till at length, the whole becomes nearly fluid, and after some additional modification, gradually passes into the state of chyme. Through all these apparent changes, however, the albumen has undergone no real change. What was introduced into the stomach as albumen, is still albumen in the chyme; at least chemists have pronounced it so to be. Yet it has assumed an appearance altogether different. The albumen of the egg, out of the stomach, may be coagulated by heat, into a firm elastic solid. The albumen of the chyme is indeed coagulable by heat, but its coagulation is so imperfect, and so wanting in tenacity, as to offer a striking contrast with the coagulated albumen of the egg. What then, in the stomach, has happened to the albumen? Viewing only its susceptibility of coagulation, the albumen has merely become chemically combined with a portion of water. The solid and tenacious albumen has, by this combination with water, been reduced to the *weakest* possible state—to the delicate state, as it were, of infancy; in short, to a state precisely analogous to that of the weak sugars, and other organic compounds, as compared with the strong and perfect varieties of the same substances, described in the preceding chapter.

Such is, we believe, an accurate account of the merely solvent or reducing powers of the stomach. We have next to show the means by which this solution or reduction is effected.

The process of combining different substances with water, and of thus reducing them from a stronger to a weaker condition, may, in some instances, and to a certain degree, be effected artificially. But in no instance do we appear to be able to invert the process; or to complete an organic compound, by again separating the water. For example, we can, in some respects, make a strong sugar weak, but we cannot change a weak into a strong sugar; though such a change, within certain limits, seems to be, to the organic agents, just as easy, as the reducing process.

The different operations of cookery, as roasting, boiling, baking, &c. have all a reducing effect; and may, therefore, be considered as preparatory to the solvent action of the stomach. Of these operations, Man's nature has taught him to avail himself, and they constitute the chief means by which he is enabled to be omnivorous: for, without such a preparation, a very large portion of the matters which he now adopts as food, would be completely indigestible. By different culinary processes, the most refractory substances, can often be rendered nutritious. Thus, by alternate baking and boiling, the woody fibre itself may be converted into a sort of amylaceous pulp; not only possessing most of the properties of the amylaceous principle, but capable of being formed into bread. The culinary art engages no small share of attention among mankind; but, unfor-

tunately, cooks are seldom chemists; nor indeed do they understand the most simple of the chemical principles of their art. Hence, their labour is most frequently employed, not in rendering wholesome articles of food more digestible, which is the true object of cookery; but in making unwholesome things palatable; foolishly imagining that what is agreeable to the palate, must be also healthful to the stomach. A greater fallacy can scarcely be conceived; for, though by a beautiful arrangement of Providence, what is wholesome is seldom disagreeable; the converse is by no means applicable to man; since those things which are pleasant to the taste are not unfrequently very injurious. Animals, indeed, for the most part, avoid, instinctively, all unwholesome food; probably because everything that would be prejudicial, is actually distasteful to them. But as regards man, the choice of articles of nourishment has been left entirely to his reason.

In order to illustrate the importance of a judicious adaptation of cookery, we may observe, that the particular function of the stomach, now under consideration, namely, the dissolving or reducing function, is liable to very great derangements. In some individuals, the reducing power is so weak, that their stomach is almost incapable of dissolving solid food of the most simple kind. In such a state of the stomach, a crude diet of the flesh of animals in a hardened state, or of other compact substances, is little else than poisonous; while the same animal and vegetable matters often agree well, if reduced to a pulpy state. On the other hand, as in the disease termed Diabetes, the solvent powers of the stomach are often inordinately increased; and every article of food is dissolved and absorbed almost as soon as it is swallowed. In such cases, a diet and a mode of preparation are required, directly the reverse of those which are found to be so beneficial, when there is a debility of the solvent powers; and aliments which are firm and solid, but at the same time nutritious, must be chosen.

Regarding the intimate nature of the agency, by which the combination of alimentary substances with water is effected in the stomach, we cannot be said to possess much certain knowledge. This combination appears to be chiefly owing to the agency of a fluid, secreted by the stomach; the glands for the formation of which fluid, are most numerous toward the pyloric orifice. The aliment having been previously broken down by mastication, and having received an admixture of saliva and of other fluids, is brought into contact with the fluid secreted by the stomach; by which secretion, or by some other energy there in operation, the food that has been introduced into the stomach is associated with water; and thus becomes itself more or less a fluid. Of this important secretion of the stomach, *chlorine*, in some state or other of combination, is an ingredient; it would seem a necessary ingredient; for the secretion in its healthy state, always contains more or less of chlorine, the

powerful influence of which elementary principle, seems mainly to contribute towards effecting the union of the food with water. The chlorine, thus so indispensable to the reducing process, is perhaps more frequently the subject of derangement, than anything concerned with the assimilation of the food. It often happens that instead of chlorine, or a little free muriatic acid, a large quantity of free muriatic acid is elicited; which not only gives rise to much secondary uneasiness, but more or less retards the process of reduction itself. The source of this chlorine or muriatic acid, must be the common salt which exists in the blood: to suppose that it is generated, is quite an unnecessary hypothesis. The chlorine is therefore secreted from the blood; and it may be demanded, what is the nature of the agency, capable of separating that element from a fluid so heterogeneous as the blood? We are acquainted with one agent that exerts such a power, namely, electricity; and this agent, as we formerly observed, seems to be employed by the animal economy for its operations, in the same manner, and on the same principles, as the materials themselves are employed, from which the animal body is constructed. Perhaps, therefore the decomposition of the salt of the blood may be fairly referred to the immediate agency of this principle, electricity. But here the question arises, What becomes of the soda from which the muriatic acid has been disunited? The soda remains behind, of course in the blood, and a portion of it no doubt, is requisite to preserve the weak alkaline condition essential to the fluidity of the blood. But the larger part of this soda is probably directed to the liver, and is elicited with the bile in the duodenum, where it is thus again brought into union with the acid, that had been separated from the blood, by the stomach. These observations, illustrating the importance of common salt in the animal economy, seem to explain, in a satisfactory manner, that instinctive craving after this substance, which is shown by all animals.

Admitting that the decomposition of the salt of the blood is owing to the immediate agency of galvanism; we have, in the principal digestive organs, a kind of galvanic apparatus, of which the mucous membrane of the stomach, and perhaps that of the intestinal canal generally, may be considered as the acid or positive pole; while the hepatic system may, in the same view, be considered as the alkaline or negative pole. Whether such galvanic action be admitted or not; and the admission is of no very great importance; what we have above stated may be received as a simple expression of the facts, in so far as they relate to the saline constituents of the blood. Moreover, be the nature of the energies what they may, by which these changes are effected; along with these changes, and probably by the aid of the same energies, other very important changes or processes are carried on, to some of which we shall presently have occasion to allude. In the mean time, we may close this section by observing that there is strong

reason to believe, that the solvent power, which we have described, or some power having a great resemblance to it, exists not only in the stomach, but in every part of an animal body. In all animals there are minute tubes, called absorbents, which originate in every part of their bodies, and at length uniting, enter the sanguiferous system along with the chyle. Now, the office of these tubes, is to remove all those portions of the animal frame, which after having performed their several functions, require to be withdrawn. Of course, before solid parts can be thus removed, they must be dissolved, (*digested* in fact;) and such solution, in many instances, is probably effected, as it is in digestion, by combining these solid parts with water. This supposed analogy between the solvent powers of the stomach, and those which must prevail all over the body, seems to be strongly confirmed by that similarity of structure and of function existing between the lacteals and the absorbents: they indeed form but one system. We shall resume this subject hereafter.

2. *Of the Powers of Conversion possessed by the Stomach.*—Though the proportions of the different ingredients of the chyle, as ultimately formed, are liable to be much varied, according to the nature of the food; yet, whatever the nature of the food may be, the general composition and character of the chyle, remain always the same. The stomach must, therefore, be endowed with a power or faculty, the agency of which is to secure this uniform composition of the chyle, by appropriate action upon such materials, as circumstances may bring within its reach. Two, indeed, of the chief materials from which chyle is formed, namely, the albuminous and the oleaginous principles, may be considered to be already fitted for the purposes of the animal economy, without undergoing any essential change in their composition. But the saccharine class of aliments, which form a very large part of the food of all animals, except of those subsisting entirely on flesh, are by no means adapted for such speedy assimilation. Indeed, one or more essential changes must take place in saccharine elements, previously to their conversion, either into the albuminous, or into the oleaginous principles. Most probably, under ordinary circumstances, these essential changes are altogether chemical; that is to say, they are such as do take place, or rather, such as would take place, if the elements of the substances thus changed in the stomach, could, out of the body, be so collocated, as to bring into action the affinities necessary to produce these changes. Thus, as we know, the saccharine principle spontaneously becomes alcohol; which, as has been stated, is merely an oleaginous body of a weak kind. When, therefore, in the stomach, it is requisite that sugar be converted into oil, it is probable that the sugar passes through precisely the same series of changes it undergoes, out of the body, during its conversion into alcohol. We cannot trace the conversion of sugar into albumen; because we

are ignorant of the relative composition, and of the laws which regulate the changes, of these two substances. The origin of the azote in the albumen, is likewise at present unknown to us; though in all ordinary cases, it seems to be appropriated from some external source. That the oleaginous principle may be converted into most, if not into all the matters necessary for the existence of animal bodies, seems to be proved by the well-known fact, that the life of an animal may be prolonged by the absorption of the oleaginous matter, contained within its own body. Thus, many hybernating animals, when they retire in autumn, to sleep during the winter, are enormously fat. But while they sleep, their fat is gradually removed; till they awake in the spring quite divested of it, and in a state of inanition.

The reader will have remarked that we have made use of the term *ordinary circumstances*; and perhaps it may not be amiss to explain what meaning we attach to that term.

When an animal is duly fed according to that diet which is natural to it, and for which its organization has been adapted; a regular and *ordinary* series of changes takes place within the animal, and the alimentary matters are converted into chyle. But one general characteristic of organized beings is that within certain limits, and for a certain time, they possess the power of varying their habits, and of accommodating themselves to circumstances. Under *extraordinary* circumstances, therefore, extraordinary changes must, and do, take place. In some instances, these changes out of the ordinary course, are to an extent altogether astonishing; and such as defy our utmost calculation. The assimilating organs appear even to decompose principles which are still considered as elementary, nay, to form azote or carbon; so that it is impossible to define what, on an emergency, these organs are capable of doing. But what is thus done by these organs on an emergency, will usually, be found to constitute an exception to what they do in ordinary; their ordinary mode of action being always that which is most simple, and which is thus to be considered as the rule.

3. *Of the Organizing and Vitalizing Powers of the Stomach*—In this part of our investigation, we meet the real difficulties we have to overcome in explaining the operations of living beings. The whole of the great and essential changes which alimentary substances undergo, may, and perhaps will be, traced by care and attention; but all beyond, will probably remain for ever unknown to us. Now at least, it may be truly said, that though we understand, in some degree, the chemical changes; of the vitalizing influence we know absolutely nothing. There is, however, every reason to believe that vitality is imparted through the agency of the living animal itself. For though, from the natural composition of alimentary substances, they be to a certain extent, fitted for the purposes of the animal economy; yet, alone, they are incapable of uniting

themselves with the animal frame; and unless the living economy contribute likewise its share of the labour, the future work of assimilation will be incomplete.

Of the Changes the Food undergoes in the Duodenum.—We alluded in general terms to the bile and the pancreatic fluids, when we were treating of the organs by which they are secreted. We have now to consider, more particularly, the nature of these secretions, and their share in the performance of the functions of the duodenum.

With the yellow colour, and the intensely bitter taste of the *bile*, all are familiar: we need not, therefore, dwell on the sensible properties of the secretion, but proceed to notice its chemical composition. The chemical composition of the bile is very heterogeneous, though not perhaps so heterogeneous as has been represented; since it is probable that many of the ingredients said to be contained in the secretion, are products that have resulted from the methods employed in its analysis. Bile, like all animal fluids, is composed essentially of water; but the solid matters contained in the bile, are nearly altogether formed from one or more proximate principles, in which carbon and hydrogen predominate. These proximate principles exist simultaneously, if not in conjunction with soda, and with various salts of soda, besides other substances. The properties of the bile vary somewhat in different animals; but in all animals its essential characters remain wonderfully similar.

We are much less acquainted with the properties of the *pancreatic fluid*, than with those of the bile. The nature of the pancreatic fluid was formerly supposed to be very analogous to that of the saliva; but recent observations have shown that it contains albumen, and a curdy substance. The pancreatic fluid is, for the most part, in a slight degree acid, and holds in solution matters of a saline nature, closely resembling those found in all animal fluids.

When the food that has undergone the first process of digestion in the stomach, quits that organ, and enters the duodenum, some other changes of a very remarkable kind take place. If the food originally contained no albuminous matter, no albumen is developed in the stomach; but immediately on the entrance of the semi-fluid mass into the duodenum, and its mixture with the bile and the pancreatic fluids; albuminous, and other chylous matters, become distinctly perceptible. At the same instant, those fluid parts, which in the stomach were acid, are so far altered, by the addition of the bile, and the pancreatic fluids, as to become neutral, or almost neutral: some gas is frequently extricated; and that portion of the food which is destined to be excrementitious, is evidently separated. The albumen, which is thus found to exist in the *chyme*, (as the food is termed, after it has been acted on by the stomach, and has entered the duodenum), may be partly derived from the pancreatic fluid, which, as we have already mentioned, has been said to contain albumen. But the quantity of albumen, and of other proximate

principles of the chyle, that are found in the contents of the duodenum, at some distance onward from the pylorus, is much too great to be explained in this manner. Indeed, the properties, as well as the quantity, of the albuminous matters, show, beyond a doubt, that the albuminous matters are developed from the food, and constitute the chyle, which is subsequently taken up by the lacteals.

Such are those most interesting, and at the same time obvious, phenomena, that are observed in different animals, in which the changes produced on the food by the action of the duodenum have been examined. These phenomena appear to vary considerably, according to the nature of the food; but so far as we can understand the phenomena, under every change of food, the essential character of the changes which the food undergoes in the duodenum, remains unaltered. That is to say: the acid formed in the stomach, combines, in the duodenum, with the alkali of the bile; the albuminous principles are developed; and the excrementitious matters are, more or less perfectly, separated. Of the nature of the more recondite and vitalizing changes which take place in the duodenum; we are in the same state of complete ignorance, as we are of the similar changes which take place in the stomach, and probably shall long so remain.

In the preceding remarks on the different processes which take place in the stomach and duodenum, and which are necessary for the conversion of the food of an animal into the living material of its body; we have endeavoured to distinguish between what, to a certain extent, is within our powers of comprehension, and what is completely beyond them. It remains to be observed in conclusion, that though the three great and essential processes of digestion, namely, the reducing, the converting, and the organizing processes be sufficiently distinct from each other; yet it is not to be understood that they take place in succession, or in the order in which they have been described. The fact is, that all these processes go on at the same time; and as soon as a portion of food begins to be dissolved, its future changes seem to be determined. If it be necessary that the portion of food undergo an essential change, that change is accordingly begun. If no such change be required, the organizing process itself begins simultaneously with the reducing process. The consequence of this union of the digestive process is, as we have stated, that the staminal principles are all developed in the chyle; as soon as the excrementitious matters are separated by the biliary and pancreatic fluids.

Of the Functions of the Alimentary Canal, beyond the Duodenum.— Compared with the functions of the stomach and duodenum, the functions of the succeeding portions of the alimentary canal, as far as we can judge, are unimportant. The digested mass passes from the duodenum into the jejunum, and ilium; though before the food

reaches the end of the ilium, the whole of the chyle contained in it, has been absorbed into the apertures of the numerous tubes named *lacteals*. These tubes open in greater or less number, into the whole interior surface of the three portions of the alimentary canal, along which the food is moved from the stomach to the colon. From the ilium, the undigested or excrementitious matters proceed into the cœcum; in which cavity, in some animals, as for example, in the horse, even these excrementitious matters appear to undergo a second digestion; but in all animals, the contents of the cœcum have a very different aspect from those of any part of the alimentary canal, nearer to the stomach. The mass of excrementitious matters continue their course from the cœcum into the colon, where they are still further changed. The nature of these changes, however, is not well understood, though they are probably of no small importance in the animal economy. Finally, all the nutritious portions of the food, having entered into the system of the animal, nothing remains but what is entirely excrementitious.

Such is a short sketch of the phenomena of digestion and assimilation, in as far as these processes are effected by the stomach and the alimentary canal. The phenomena suggest the following reflections :

First. With regard to the nature and the choice of aliments, and the modes of their culinary preparation; it follows from the observations we have offered; that, under similar circumstances, those articles of food, which are the least organized, must be the most difficult to be assimilated: consequently, that the assimilation of crystallized, or very pure substances, must be more difficult, than the assimilation of any others. Thus, pure sugar, pure alcohol, and pure oil, are much less easy to be assimilated, than substances purely amylaceous; or than that peculiar condition or mixture of alcohol existing in natural wines; or than butter. In these forms, the assimilation of the saccharine and the oleaginous principles is comparatively easy. Of all crystallized matters, pure sugar is perhaps the most easily assimilated; but every one is taught by experience, that much less can be eaten of articles composed of sugar, than of those composed of amylaceous matters. In some forms of dyspepsia, the effect of pure sugar is most pernicious; perhaps fully as pernicious as that of pure alcohol. Nature has not furnished either pure sugar or pure starch; and these substances are always the results of artificial processes, more or less elaborate; in which, as in many of the processes of cookery, man has been over-officious; and has studied the gratification of his palate, rather than followed the dictates of his reason. In many dyspeptic individuals, the assimilating and preservative powers of the system, are already so much weakened, as to be unable to resist the crystallization of a portion of their fluids. Thus in gouty invalids, how often do we see chalk-stones formed in every joint? Now, with so little control over their own fluids, how can they reasonably hope to assimilate extraneous crystallization? If, therefore, such an in-

valid, on sitting down to a luxurious modern banquet, composed of sugar, and oil, and albumen, in every state of combination, except those best adapted for food, would pause a moment, and ask himself the question; Is this debilitated and troublesome stomach of mine, endowed with the alchemy requisite for the conversion of all these things into wholesome flesh and blood? He would probably adopt a simpler repast, and would thus save himself from much uneasiness. The truth is, that many of the elaborate dishes of our ingenious continental neighbours, are scarcely nutritious, or designed to be so. They are mere vehicles for different stimuli—different ways, in short, of gratifying that low animal propensity, by which so many are urged to the use of ardent spirits, or of various narcotics. In one respect indeed, namely, that of reducing to a state of pulp those refractory substances which we have before mentioned, the culinary processes of our neighbours are much superior to ours; but in nearly every other respect, and most of all, in the general use of pure sugar and pure oil, their cookery is eminently injurious to all persons who have weak digestion. On the other hand, in this country, we do not in general pay sufficient attention to the reducing processes of the culinary art. Everything is firm and crude; and though the mode of preparation be less captivating; the quantity of indigestible aliment is quite as great in our culinary productions, as in those of France.

We are not, however, writing a treatise on cookery or dietetics; but in treating of the function of digestion, it is impossible altogether to pass over these important subjects. The foregoing observations are merely intended as illustrations of those general principles which often regulate the choice, and the preparation of the food of mankind, in a state of civilized society. Reason is too little followed, the indulgence of the palate is the sole object; so that the organs of digestion already enfeebled, and incapacitated for the assimilation, even of the most proper nourishment, are daily oppressed with a task for which they are altogether unequal. The consequence is, that though for a time the labour be sustained, the digestive energies are at length overcome. The dyspeptic being passes half his days in misery; his offspring inherit their parents' constitution; and if they persist in a like course of slow poison; after a few generations, the race becomes extinct,—“his name even is cut off from among men!” Providence has gifted man with reason; to his reason, therefore, is left the choice of his food and drink, and not to instinct, as among the lower animals: it thus becomes his duty to apply his reason to that object; to shun excess in quantity, and what is noxious in quality; to adhere, in short, to the simple and the natural; among which the bounty of his Maker has afforded him an ample selection; and beyond which if he deviates, sooner or later, he will suffer the penalty.

Secondly. The view we have now taken of the processes of diges-

tion, removes in some degree that mysterious character with which they have been invested; and by lessening the field of our inquiry, brings us nearer to our object. We had previously known, that the articles employed as food by animals are essentially composed of three or four elements. But we have now learnt, that all the more perfect of those matters on which animals subsist, are compounds of three or four proximate principles; the whole of which compounds, except one, are, in their essential characters, identical with those composing the frame of the animals themselves. We have also learnt, that owing to this identity of composition, many animals are saved the labour of forming these proximate principles from their elements; and have only to re-arrange them, as their exigences may require. The task of forming the proximate principle is thus left to the inferior animals or to plants; which are endowed with the capacity of compounding them from matters still lower than themselves, in the scale of organization. Hence there is a series, from the lowest being that derives its nourishment from carbon and carbonic acid, up to the most perfect animal existing. Each individual in the series preferring to assimilate those immediately below itself; but having on extraordinary occasions, and in a minor degree, the power of assimilating all, not only below, but above itself, in the system of organized creation.

We stated that the immediate influence employed by the organic agent is probably galvanism, or the common agents that operate among inorganic matters; and that the digestive apparatus, viewed as a whole, seems to be arranged on galvanic principles. We wish, however, our readers clearly to understand, that we consider the organic agent residing in the ganglionic system of nerves, and employing the electric agency, to be *not* electricity itself; though the agency is probably the lowest kind existing in animal bodies, and only, as it were, one degree above the agencies of inanimate matter. We dwell on this point the more, because from deficient recollection of what electricity is, and what are the living powers acting through the nervous system of animals, it has been maintained, nay, has even been endeavoured to be experimentally proved, that these nervous powers are identical with the powers of electricity. It is impossible to imagine a greater fallacy. Admitting that electricity, properly directed, could change the proximate elements of the food into those of chyle; can we imagine this principle to vary spontaneously its mode of operation, so as to produce the same chyle from every sort of aliment—that electricity is an *intelligent* agency acting with a certain object? Besides, if the nervous agency be identical with electricity, how different must be its functions in different nerves; in one nerve, for example, digesting and assimilating the food; in another conveying sight; in a third conveying sound; in the brain itself, shall we say, actually thinking! As to the experiments, on which it has been attempted to rear this most untenable opinion, they prove nothing whatever; and are easily explained on other principles.

Such explanation would be foreign to our present object, were we to introduce it here. But there is one observation, which has always appeared to us conclusive against this fancied identity of the nervous energy with electricity; and with which, we shall close what we have to offer, regarding the present subject. Most persons are aware that there are certain fishes endowed with the power of evolving electricity, and of communicating a smart shock to other animals. Now, in all the fishes in which this power resides, as in the Torpedo, there is a complicated apparatus, extending over a large portion of the fish's body, expressly for the purpose of forming the electricity, which the fish communicates; thus, proving beyond a doubt, that mere nerves are not sufficient to develop electricity; and that, when electricity is wanted, an express and peculiar organ is as requisite for its secretion or formation, as for the secretion and formation of any other product of the animal economy.

The reflections suggested by the facts we have now detailed, will be given in conjunction with those suggested by the facts to be detailed in the next chapter.

CHAPTER IV.

OF THE PROCESS OF ASSIMILATION SUBSEQUENT TO THOSE IN THE STOMACH AND ALIMENTARY CANAL; PARTICULARLY OF THE CONVERSION OF THE CHYLE INTO BLOOD. ON RESPIRATION, AND ITS USES. OF SECRETION. OF THE FINAL DECOMPOSITION OF ORGANIZED BODIES. GENERAL REFLECTIONS, AND CONCLUSION.

1. *Of the Passage of the Chyle from the Alimentary Canal into the Sanguiferous System; and of the Function of Absorption generally.*—The Chyle, as we have already said, is taken up from the alimentary canal, by numerous minute tubes, named *lacteals*; these tubes being part of the system of similar tubes, which arise from all parts of the body, and are termed *absorbents*. The whole of the absorbing tubes, after passing through various glands, at length unite into one or two of larger size; that on the left side being by far the largest, and known by the appellation of the *thoracic duct*. These larger absorbent tubes pour their contained fluids into the veins named the *sub-clavian*; and thus into the general mass of the blood. The exact nature of the changes which the chyle and the lymph undergo in their passage through these tubes, is not well understood. One change appears to be, that the chyle, as first formed in the alimentary canal, is to a certain extent, *completed*, or freed from water, during its course through the lacteals: for though, when the

chyle is mixed with the blood, its albuminous principles are much less perfectly developed than those of the blood itself; yet their developement, on their mixture with blood, is more perfect, than when the chyle is first taken up from the alimentary canal.

The matters conveyed from the other parts of the body, by the tubes of the general absorbent system, have, by most physiologists, been supposed to be of an excrementitious character. That some of the absorbed matters are excrementitious, is very probable; arguments may, however, be adduced, to show, that the whole of the matters absorbed are by no means excrementitious; but that they are repeatedly consigned to the uses of the vital agency: every new organization raising them, as it were, a step higher, and qualifying them for those refined and ulterior purposes; for which the crude chyle can hardly be imagined to be at once adapted.

The circumstances favouring the above opinion, which we are now desirous to mention, are—

First. It is unreasonable, and contrary to everything we know respecting the operations of the animal economy, to suppose that the chyle should be separated from one kind of excrementitious matter, in the alimentary canal; in order to be immediately mixed again with other excrementitious matters, in the chyloferous tubes. It is, therefore, a just inference, that if the matters contained in the absorbents are really and wholly excrementitious, they would be carefully kept apart; and would be removed from the system by some other means, than by tubes united with those conveying the nutritious fluids.

Secondly. By admitting that the fluids contained in the absorbent tubes possess a highly animalized character, the design of their union with the crude and imperfectly animalized chyle, becomes apparent: the fluid in the absorbents will be seen to execute an important and necessary office; by raising the vital character of the chyle, and qualifying it, for becoming a part of the general mass of the blood. We thus obtain a cogent reason, why the fluids taken up from the internal surface of the alimentary canal, should be mingled with those that are absorbed from other parts of the body; a mixture which is inexplicable, on the hypothesis of these absorbed fluids being wholly excrementitious.

Thirdly. The gradual developement of the staminal principles of animal bodies, by repeated organizing processes, fully accords with those general views of the operations of nature which, throughout this work, we have endeavoured to illustrate; and which lead to the general conclusion, that the operations of nature are never abrupt, but always slow and gradual. Further, it is more reasonable to conceive, that matters already assimilated to the animal body, are better fitted for its immediate uses; than those which, like the chyle, have only received an imperfect assimilation.

Fourthly. Many animals can and do live, for a considerable

time, on substances contained in their own bodies. Thus hibernating animals, as previously stated, have the ability to assimilate principles of the blood, gelatine is not mentioned. In fact, though further, those matters which have already become part of themselves; consequently, such a faculty of progressive organization as we have supposed, actually exists; and *a sort of digestion is carried on in all parts of the body, to fit for absorption and future appropriation, those matters that have been already assimilated.* Were it necessary, other arguments to the same effect might be added: but we shall at present delay the further consideration of the assimilating character of the whole absorbent system; that we may recur to it again, in a succeeding part of the present chapter.

2. *Of the Blood.*—The blood is that well-known fluid pervading the tubes, named from their function the *blood-vessels*; which tubes are extended more or less over every part of an animal. We have already described the general distribution of the blood-vessels; and shall now confine ourselves chiefly to the properties of the blood itself.

The chyle, as we have stated, is poured into the general mass of the blood near the heart; and from the heart is almost immediately propelled through the lungs. The chyle, thus set in motion, is not only united thoroughly with the blood; but undergoes those other important changes, by which its final conversion into blood is accomplished. The exact nature of these changes is unknown; but they are evidently of a completing character—that is to say, the weak hydrated ingredients of the chyle, are freed from a portion of the water with which they were associated; and are transmuted into the strong albuminous matter of the blood.

The chief constituents of the blood are essentially albuminous. Blood contains albumen in three states of modification: namely, *albumen*, properly so called; *fibrin*; and the *red particles*. In addition there are *oily* matters; besides various minute portions of other animal matters, and *saline* matters, all dissolved, or rather suspended, in a large quantity of water. The following short table exhibits the relative proportions of the constituents of human blood to each other, as they exist in most individuals.

ONE THOUSAND PARTS OF HUMAN BLOOD CONTAIN

Of Water	-	-	-	-	-	-	783,57
Fibrin	-	-	-	-	-	-	2,83
Albumen	-	-	-	-	-	-	67,25
Colouring matters	-	-	-	-	-	-	126,31
Fatty matters, in various states	-	-	-	-	-	-	5,16
Various undefined animal matters, and salts	-	-	-	-	-	-	15,08

1000,00*

* Le Canu; mean of two analyses.

The reader will not fail to remark, that among these constituents existing most abundantly in various animal structures, *gelatine* is never found in the blood, or in any product of glandular secretion. We formerly noticed that gelatine appears to rank lower than albumen in the scale of organized substances; and we may now add, that a given weight of gelatine, contains at least three or four per cent. less carbon, than an equal weight of albumen. The production of gelatine from albumen must, therefore, be a *reducing* process. We shall presently have occasion to revert to these facts. In the mean time we subjoin the few observations we have to offer, on the organization or structure of the blood.

The organization of the blood is even more wonderful than its chemical composition, and is still less understood. The red portion of the blood, for example, is composed of innumerable minute globules, varying in size in different animals; and in all instances, highly organized: the real structure indeed of these globules is very imperfectly known; but they are generally supposed to be formed of solid colourless nuclei, within red vesicles. The fibrin, also, is diffused through the mass of the blood in a state of equally minute subdivision; though the particles of the fibrin are colourless, and their magnitude much less than that of the red particles. From this inferiority in size, some physiologists have been led to think, that the colourless particles of the fibrin, are identical with the nuclei of the red particles. During the life of an animal, the particles of the fibrin, as well as the red particles of its blood, seem to be in a state of extreme self-repulsion; by which self-repulsion, the union of these particles is prevented; except as the economy of the animal may require, and may determine. After death, however, or in blood withdrawn from the body of a living animal, the property of self-repulsion, more especially among the fibrinous particles of the blood, ceases, and they readily cohere: this cohesion is termed the *coagulation* of the blood. Much beautiful design is probably concealed under that peculiar organization of the blood, to which it owes its coagulating tendency. One result of the coagulation of the blood, indeed, is as obvious as it is important; namely, the prevention of hemorrhage. If the blood did not coagulate, the existence of animals would be most precarious; as on the slightest injury, they would be liable to bleed to death.

3. *Of Respiration.*—The function of *Respiration*, or breathing, is one of the most important in the animal economy, and cannot, like many of the other functions, be suspended; the interruption of that function being immediately destructive of life. When we described the phenomena of the circulation of the blood, we observed, that the blood, in passing through the lungs, is exposed to the action of the atmospheric air. Now, during this exposure of the blood to the atmospheric air, it undergoes certain changes. The blood from the right side of the heart, when it enters the lungs, is of a dark red co-

lour ; it is then dispersed, in a state of most minute subdivision, through the ultimate vessels of the lungs, and in these vessels is brought into contact with the atmospheric air, and becomes of a bright red colour. In other words, the blood changes in the lungs its *venous* appearance, and assumes the character of *arterial* blood. The blood thus arterialized, returns to the left side of the heart, and from that organ, is propelled through the whole arteries of the body. In the minute terminations of the arteries, the blood again loses its florid hue, and, re-assuming its dark red colour, is returned to the veins, to the right side of the heart ; to be exposed as before to the influence of the atmospheric air, and to undergo the same succession of changes.

On examining the respired air, a remarkable alteration of its properties is found to have taken place ; a portion of its oxygen has disappeared, and a similar bulk of carbonic acid gas, has been substituted. With respect to the origin of this carbonic acid gas, there have been various opinions. Formerly, the greater number of physiologists maintained, that carbon, in some form, was excreted by the lungs ; and that this excreted carbon, uniting with the oxygen of the inspired air, was converted into carbonic acid gas. No one imagined that oxygen gas could be passing inwards through the membrane of the lungs, while carbonic acid gas was, at the same time, passing outwards, through the same membrane. Accurate observations have, however, demonstrated, that such a simultaneous passage of gases really takes place through the membrane of the lungs ; and the observations are not confined to the two gaseous bodies in the lungs ; but are applicable to all gases whatever, under similar circumstances. In consequence of these observations, it seems now to be generally admitted, that the oxygen of the atmospheric air is absorbed by the blood, and, in some unknown state of combination, reaches the extreme subdivisions of the arteries ; where it is united with a portion of carbon, and forms carbonic acid gas : that this carbonic acid gas is retained in some unknown state of combination in the venous blood ; till, in the lungs, it is expelled, and oxygen is absorbed in its stead ; according to the laws which regulate the diffusion of gaseous bodies, formerly explained. Further, with the carbonic acid gas, a large quantity of aqueous vapour, as we have stated, is at the same time separated.

It would be foreign to the objects of this treatise, were we to enter further into the reasons for the view we have given of the phenomena of respiration. These reasons are many and strong ; and seem indeed to prove clearly, that the changes which the blood undergoes, during its circulation through the body, are as we have described them. We shall, therefore, assume that our view of respiration is correct ; and shall offer a few remarks on the attendant circumstances, and on the consequences of respiration.

First. To what influence are we to ascribe the different colours

of arterial and of venous blood? The opinion formerly held, was, that the arterial colour arose from the absorption of oxygen; and the venous colour from the presence of carbon. But recent observations seem to show that the change in the colour of the blood during its circulation, if not entirely independent of oxygen, is much influenced by the saline matters; particularly by the common salt, which the blood contains: and that the dark colour of venous blood, is principally owing to the presence of carbonic acid gas.

Secondly. What is the source of the carbonic acid in venous blood, and of the aqueous vapour that is expelled from the lungs? These questions cannot be answered with certainty. But some observations lately made, have induced us to believe, that the *conversion of albuminous matters into gelatine*, is one great source of the carbonic acid in venous blood. Gelatine, which, as before observed, contains three or four per cent. less of carbon than albumen contains, enters into the structure of every part of the animal frame, and especially of the skin: the skin indeed consists of little else besides gelatine: it is most probable, therefore, that a large part of the carbonic acid of venous blood is formed in the skin, and in the analogous textures. Indeed, we know that the skin of many animals gives off carbonic acid, and absorbs oxygen; in other words, performs all the offices of the lungs; a function of the skin perfectly intelligible, on the supposition that near the surface of the body, the albuminous portions of the blood are always converted into gelatine. With respect to the aqueous vapour thrown off from the lungs: we have every reason to believe, as before stated, that much of this vapour is *derived from the chyle*, in its passage through these organs; and that by such separation of water, the *weak* and delicate albumen of the chyle, is converted into the *strong* and perfect albumen of the blood; according to the principles detailed at the commencement of this chapter.

Thirdly. What are the uses of the continual extrication of carbonic acid from living animals; and could not a little superfluous carbon have been thrown off from their bodies in a more simple manner? The precise use of the constant evolution of carbonic acid, or how it is effected, we know not; but one great use which has been assigned to this evolution, is, the formation of the heat of the body; and not only the power of forming that heat; but also the power of varying it according to circumstances—a power so characteristic of organized life. Out of the body, carbon does certainly give off heat on combination with oxygen. Hence, it has been maintained with great plausibility, that the same combination, within a living body, may give origin to its heat; though it must be confessed, that there are some difficulties about this view of the origin of animal heat, which detract considerably from its likelihood. Moreover, it is exceedingly probable, that though the evolution of carbonic acid gas, may be one of the means possessed by

the animal economy for generating heat; there are yet other means, the nature of which at present are quite unknown.

The quantity of carbon thrown off by the lungs, is very abundant; but has probably been much overrated. Philosophers have, for instance, calculated that the lungs of a man of ordinary size expel, in the course of twenty-four hours, eleven ounces of carbon; a quantity more than equal to that contained in six pounds of beef.* If carbon be indeed thrown off from the lungs so copiously; it must be produced in the body. It is difficult to account for the quantity of carbon thrown off, even on the lowest estimate. We are, therefore, necessarily obliged to conclude, that more solid matter is every day expelled from the body by the lungs, than in any other manner. Hence the probability of the opinion formerly noticed, that the matters taken up by the absorbents, and by the veins, enter successively into the formation of various parts of the animal frame; instead of being removed, immediately after their absorption, as at present is generally supposed. For it seems hardly possible to reconcile, with the quantity of food, the great quantity of carbon that is expelled from the lungs alone; much less, what must be expelled if all the matter taken up by the absorbents be likewise considered excrementitious.

4. *Of Secretion.*—From the blood, are formed, by means of peculiar apparatus, all those numerous products termed *Secretions*; not only so unlike each other, but so unlike the fluid from which they are originally separated. Some of these secreted products appear to be little else, than a separation of certain matters already existing in the blood. Other secretions have no resemblance to any ingredient of blood: consequently, in the glandular structure, by which these secretions, so dissimilar to the blood, are formed, the blood must undergo some essential change. In the present state of our information, however, we must content ourselves with a limited insight into the nature and the causes of secretory action. We see that secreted products are of two kinds; that some of the matters separated by animal bodies are evidently thrown off, on account of their noxious qualities; are, in fact, *excretions*; which could not be retained without proving fatal to the life of the animal from which they are detached: while others again, are as obviously intended for further objects, and for the performance of various subordinate actions in the living system; are in fact, *secretions*; properly so called. But as we have stated, we are still perfectly unacquainted with the intimate

* According to an elaborate analysis, by Berzelius, the muscle of an animal contains 77 per cent. of water, and 23 per cent. of other matters. Supposing, what is near the truth, that 22 of these 23 parts consist of albumen, and that this albumen contains half its weight of carbon; which in round numbers is sufficiently neat approximation; it follows, that 100 parts of the muscular fibre of animals, contain about 11 parts of carbon; so that 11 ounces of carbon must represent 100 ounces of beef; that is, upwards of six pounds as stated in the text.

nature of these changes ; though it is probable that a careful examination of the phenomena, would throw much light on their general character ; and display evidence of the most consummate design.

5. *Spontaneous decay of Organized Bodies.*—It remains finally to close this work with a few observations on the spontaneous, and inevitable decay, of all those things that are produced by organization ; after they have been removed from the influence of the organic agents, by which the combination of their constituent principles was effected.

The organized beings that inhabit this globe, however numerous, have a very small relation to the magnitude of the globe, and seem to occupy its surface only. We have seen that the elements forming the structure of these beings, are not only combined in different proportions, but that they appear, in many instances, to undergo further decomposition into ultimate forms of matter, which, out of a living body do not, and perhaps, in the present constitution of the universe, cannot, exist in an isolated state. Owing to this diversity in the composition of organized beings from that of inorganic matter, and to other causes which will readily occur to the reader, organized beings and their laws, are in continual opposition to the general laws, by which inorganic matter is governed. To counteract, therefore, these opposite laws, and to maintain the existence of organized beings, require the unremitting efforts of the organic agency. But at length these efforts are exhausted ; the contest ceases ; when the general laws of inorganic nature prevail, and speedily reduce, to their original state of existence, the atoms which had been incarcerated in the living frame.

The spontaneous decay of organized beings is usually termed the *putrefactive* process ; and some substances are much more prone than others, to undergo that change. As might be expected ; those substances whose constitution is most simple, as the oils, and bodies of a like nature, are also the most permanent ; while substances more compounded, especially those which include azote, are exceedingly liable to putrescent change. For such changes a certain degree of heat and of moisture appear to be necessary : since in a temperature below the freezing point of water, or in a perfectly dry state of the atmosphere, even animal substances may be preserved unchanged during any length of time. The phenomena attending the dissolution of different kinds of organized matters are of course different ; but in every instance, the tendency is toward the formation of compounds more simple than the matter decomposed ; that is to say, of compounds whose existence, out of a living body, is not incompatible with the present state of the globe. Those matters which, in a warm and damp air, seem first to be loosened from organic combination, are those foreign bodies we formerly mentioned, as existing, in every part of the structure of organized beings, in some unknown but active self-repulsive state. Hence, during putrescent ac-

tion, arises the formation of sulphuretted and phosphoretted hydrogen, and of other undefined compounds of the same elements: and these gaseous compounds, chiefly, produce the very offensive odour of putrefaction. At the same time, there are formed, carburetted hydrogen, oil, acetic acid, ammonia, and last of all, carbonic acid gas and water; while the azote is extracted in a gaseous condition. Finally, both vegetable and animal matters, but vegetable matters more especially, are reduced to the state of mould. The mould from vegetable matters, consists principally of carbon, in combination with a little oxygen or hydrogen: the mould from animal products, consists of similar matters, mixed with a little azote, and the usual saline ingredients of organized substances. In this form of mould, the remains of vegetables and of animals, as was before stated, constitute the food of plants; by which they are again organized, and thus go through the same series of changes.

We may here pause for a moment, and, on account of the general reader, briefly recapitulate the most striking facts, that have been detailed in the present, and in the preceding chapters.

In this first place, the *mechanical arrangements* for reducing the food of animals to the proper degree of comminution, are wonderfully varied, according to the peculiar qualities of that food. In the graminivorous and granivorous tribes, for example, the teeth are literally instruments for grinding or triturating herbaceous matters, and seeds. In carnivorous animals, such a structure would be useless; the teeth therefore, are suited only for cutting, or tearing. In gnawing animals, the teeth present a totally different structure, but at the same time are admirably fitted to the habits of the animal. Occasionally, as in the fowl tribe of birds, the grinding apparatus is placed, not in the mouth, but in the stomach itself; this organ being, as it were, expressly contrived for trituration; while some of the functions it performs in other animals, are transferred to contiguous parts.

The structure and mechanism of the stomach, and of the alimentary canal, then claim our particular attention. In carnivorous animals, whose food requires comparatively little assimilation, the alimentary canal is short, and of a simple structure. On the other hand, in vegetable feeders, that canal is long and complicated; but perfectly adapted for macerating their food, and for extracting from it, everything that can be converted into nourishment. Nor is there an adherence to any model, but the whole is throughout varied; as if in order to demonstrate the power and the wisdom of Him by whom they were contrived. Thus the alimentary canals of the cow, and of the horse, are formed on entirely different models; though the food of both animals be nearly the same.

We proceed in the next place, to the consideration of the *chemical changes*, which the food undergoes in the stomach and duodenum. In these changes we discover arrangements not less wonderful, in-

deed more wonderful, than in those of structure and of mechanism. The variety of forms, assumed by bodies having the same essential composition, produces a latitude, in the choice of diet, which is almost infinite: at the same time, the organs being endowed with the power to discriminate all these differences, and to act on the ultimate principles of bodies; elaborate, from all these various forms of matter, the same uniform resulting chyle. The power by which the stomach is enabled to effect these astonishing changes, is the power which it possesses, of associating the different alimentary substances with water; the power, in short, of dissolving or digesting them. This dissolving power seems to be exerted through the agency of chlorine, derived from the common salt in the blood; at least, chlorine is always present in the stomach, during the act of the solution of the food; though the precise mode in which it operates, is still unknown. Contemporaneously with the act of solution of the food, such essential changes take place in its composition, as are requisite for perfecting the future chyle.

The stomach having accomplished its office, the digested mass enters the duodenum; where the series of changes is continued in a manner equally wonderful. In the duodenum, the digested mass is brought in contact with the biliary and the pancreatic fluids. The alkali of the bile unites with the acid, with which the food had been mingled during its digestion in the stomach; the excrementitious parts, both of the food, and the bile, are separated or precipitated; while at the same time, the proper chylous principles are eliminated, in a condition appropriate for their absorption by the lacteals.

There are two divisions of these minute tubes, that compose what is termed the absorbent system of animals;—the lacteals—and the absorbents properly so called. The ultimate ramifications of the lacteals, originate from the internal surface of the alimentary canal, where they take up the digested, and partly assimilated, element or chyle. The ultimate ramifications of the proper absorbents, originate from all parts of the body; and are enabled to take up, by some peculiar process, every component of the body, solid as well as fluid, in the same manner as the chyle is taken up by the lacteals.

The fluid obtained from the lacteals, and that obtained from the proper absorbents, are both alike albuminous. The albumen of the chyle, as we have formerly shown, is produced in the stomach and duodenum, while the food is undergoing the process of digestion. But whence is the albumen derived, that is found in the proper absorbents? The animal body we know to be composed of a great variety of matters, among which gelatine predominates. Now, since albumen only is found in the absorbents, it follows, that before the gelatine of the body is taken up by the absorbents, it is reconverted into albumen: in other words, the absorbed gelatine undergoes a process, entirely analogous to that which gelatine, and other matters, undergo in the stomach and duodenum, during the process of diges-

tion. Hence, the digestive process, instead of being confined to the stomach and duodenum, is actually carried on without intermission, in all parts of a living animal body.

The two kinds of fluid albumen derived from these two sources; that is to say, the crude chyle in the lacteals, and the highly animalized lymph in the absorbents, are at length commingled; and form one uniform fluid of an intermediate character, adapted for becoming a part of the general mass of the blood. The character however of this fluid, when it becomes part of the blood, though albuminous, is still very *weak*; that is to say, the fluid consists of albumen, holding a large proportion of water in a state of essential combination. By a beautiful arrangement, as soon as this weak albuminous fluid is mingled with the blood, it is hurried through the lungs; where it undergoes a remarkable change. In the lungs, the water, which is in essential union with the weak albuminous matter of the chyle, is separated and expelled along with the carbonic acid gas, which is continually escaping from these organs; and at the same time, the weak and delicate albuminous matter of the chyle, is converted into the strong and firm albuminous matter of the blood. We are thus brought to consider the process of respiration.

The blood, in its course through the lungs, emits carbonic acid gas, and assumes a florid *arterial* colour. At the same time, according to the principles of gaseous diffusion, the blood absorbs, in the lungs, a portion of oxygen from the air of the atmosphere. The oxygen thus absorbed, remains in some peculiar state of union with the blood, (Query, as oxygenated water, or some analogous compound?) till the blood reaches the ultimate terminations of the arteries. In these minute tubes the oxygen changes its mode of union; it combines with a portion of carbon, and is converted into carbonic acid; which carbon must be derived from the albuminous principles of the blood. Two distinct alterations take place during the union of the carbon with the oxygen: a portion of the albumen contained in the blood is supposed to be reduced to the state of gelatine; which gelatine is appropriated toward the renovation of those textures whose composition is chiefly gelatinous: at the same time, the carbonic acid which had been formed from the reduced albumen, unites with the blood, communicates to that fluid its dark *venous* colour, and is transferred to the lungs; where it is expelled from the system, along with a portion of aqueous vapour, derived principally from the weak albumen of the chyle; as formerly explained.

The blood is the source, not only of all the constituent principles of animal bodies, but likewise of all the various *secretions*; many of which differ altogether, in their properties, from those of the primary fluids, and perform secondary offices, of great importance in the animal economy. Other products separated from the blood, are purely *excretions*; as, for instance, the carbonic acid gas from the lungs; which could not be retained in the animal system without destroying life.

Finally, the life of the animal becoming extinct, the essential properties of the matter of which it is composed, resume their natural action, and speedily restore the elements to their original condition.

Such is a summary of those operations of living bodies, which, in the present and in the preceding chapters, we have endeavoured to illustrate; and though our insight into those operations be very imperfect, it is amply sufficient to satisfy us, of the infinite wisdom by which they are directed; and that the unknown, must be far more wonderful than what has been disclosed. Most of the facts on which we have dwelt, are of a character so obvious, that they require only to be understood, in order to be admitted among the proofs of the great argument of design; at least, by all, but those who affect to deny that argument. We therefore leave to the reader, the application of facts, so obviously demonstrative of design; and proceed to offer a few remarks on certain general arrangements of organized and living beings, relatively to those of inorganic matter.

First. In considering the economy of organized beings, one of the circumstances most calculated to arrest our attention, is the extraordinary skill manifested in the disposal of the various parts of the organized system, with regard to each other. As an instance, on the great scale, may be noticed, the mutual relation and dependence of plants and animals. Thus, as we formerly pointed out, carbonic acid gas constitutes the chief food of plants; and we now see, that nearly the whole of the superfluous carbon produced by the operations of the animal system, is actually thrown off in the form of carbonic acid. Plants, therefore, on the one hand, supply the chief nourishment to animals; while that gaseous matter which is separated by the animal economy, and which if retained within animals, would to them be fatal, constitutes, on the other hand, the chief food of plants. Nor in these two respects only, are the two great systems of organization mutually dependent; for unless plants consumed the carbonic acid gas which is formed by animals; this deleterious compound would probably accumulate in the atmosphere, so as to destroy animal life; while it is doubtful, whether the present races of vegetables could exist, if carbonic acid gas were not formed by animals. Again, the general scheme of Providence, for the nourishment of animals, claims our especial notice. Animals have not only been destined to prey on each other: but all created beings are the food of those progressively higher than themselves, in the scale of organization. By this wise arrangement, the labour of the assimilating power has been greatly diminished; and by the same means, that accumulation of dead animal remains which soon would be overwhelming, is entirely prevented. Even in the fabric of individual animals, and in the operations carried on within them, the same wise purposes of mutual relation and dependence are observable. Thus, whether we contemplate the repeated employment of the same materials; or the various important ends, in many instances accom-

plished by the same process; we discover, throughout, the utmost abridgment of labour; so that the greatest possible effect, is every where produced, by the simplest possible means.

Secondly. The general subserviency, of the mechanical arrangements of the frame of organized beings, to the chemical operations that are carried on within them, is of still greater interest and importance, than even those arrangements have been shown to be. We may view an organized being as a piece of intricate machinery, adapted to the physical, and the chemical properties of matter. The adaptation of this machinery to the physical properties of matter, belongs to another department. Our attention is directed solely to the chemical adaptations. The performance of the chemical changes within organized beings, through the interposition of mechanical arrangements, as has been stated in a former part of this work, establishes, beyond a doubt, that these chemical changes have a real existence. Thus, when we witness such a display of elaborate arrangements, as are exhibited in the mechanism of the digestive organs, and of the circulating system; the purpose of which arrangements is merely to produce a few chemical changes in the food, and in the blood; it is evident that the chemical changes so produced, must be at least as real, as the mechanical structure, by means of which they are effected. Hence the adaptations of mechanical arrangements, in the structure of organized beings, to the pre-existing chemical properties of matter, affords an evidence of design, not less impressive than unequivocal. The most determined sceptic cannot assert that there is any *necessary* relation, or indeed any relation whatever, between the mechanical arrangements, and the chemical properties to which they administer. There is no reason why the chemical changes of organization, should result from the mechanical arrangements, by which they are accomplished: neither is there the slightest reason, why the mechanical arrangements in the formation of organized beings, should lead to the chemical changes of which they are the instruments. From what cause, then, arose the association of the chemical changes with the mechanical arrangements? How were the chemical operations of digestion and of respiration brought into union with the mechanical apparatus of digestion, and with the circulating system? The co-existence of things so entirely dissimilar, and having no kind of mutual relation, can be explained only on the supposition that *a will exists somewhere*; and also a *power to execute that will*. The existence is thus unavoidably acknowledged of a Being, who knowing every pre-existing chemical property of matter, and willing to direct these properties to a specific object, has contrived for that purpose an apparatus admirably fitted to attain His object. Such is the explanation—the only possible explanation, of the subserviency of mechanism to chemistry, in the processes of organic life. And

what is this explanation, but our *argument of design*, in terms that seem absolutely irresistible?

Thirdly. That perpetual renovation and decay to which all organized beings are liable, may be considered as a part only of the great round of changes, which we witness in everything that has been created. The world itself, as we have seen, appears to have been, at intervals, subjected to changes involving even the fundamental laws by which it is governed. Nothing, therefore, belonging to the world, can reasonably be expected to be permanent. Had there been even an approach to such permanence, the beautiful adaptations of organized beings to the pre-established laws of inanimate matter, and all the other wonderful arrangements we have described, could not have been manifested as they now are. Besides, to the changes we ourselves undergo, we are indebted for the greater part of the enjoyments of our life. If none died, none could be born; and the present arrangements of human society could have no existence. There would be none of the pleasing relations of parent and offspring; none of the agreeable variety of childhood, of youth, of maturity, and of age, experienced by every individual; which, with all the other numerous relations of society, incidental to the persons of different individuals, contribute so largely to human happiness. Were man exempt from change; whether the rest of the world were supposed to be progressive, as it is; or whether it were stationary, as regards him; the same uniform and dull monotony would prevail, the same want of motive. In short, with our present constitution and feelings, perpetuity and uniformity would be physically and morally impossible.

But why, it has a thousand times been asked, why has the world been so constituted? Why this unceasing round of change? Whence its origin? What its object?—Such questions, the Great Author of the universe alone can answer. But as within those narrow limits by which our observations are bounded, wherever we can trace His designs, we see that His works are never without an object; we cannot doubt that in determining their perpetual change, there is no less an object; though it be above our comprehension. By placing immaterial and intelligent beings, for a time, in personal connexion with matter, He has indeed communicated to them a knowledge of those properties of matter which so strikingly display His wisdom and power; and this may have been one of His objects;—but to speculate further on points so utterly beyond our capacity, would be presumptuous: for who can “know the mind of God, or who hath been His counsellor?”

We have thus given a brief outline of what has been denominated the Chemistry of organization; in other words, an account

of those changes and combinations which, through the operation and the agencies of inorganic matter, organic agents are capable of effecting. The information it has been in our power to give, though imperfect, we have shown to be amply sufficient, not only to demonstrate the astonishing wisdom, and foresight, with which organized beings, in as far as we can understand them, have been contrived and formed; but the infinitely higher perfection of both these attributes, requisite to impart to organization that vitality, the nature of which so entirely surpasses our conception.

We shall now close this volume with a few observations on the future progress of chemistry; on the means by which this science may be applied to physiological research; and on the tendency of physical knowledge in general.

Chemistry as we pointed out in the introduction to this treatise, forms the connecting link between those branches of human knowledge which are founded on quantity, and those which are derived solely from experience. All our experimental knowledge that is not chemical; for instance, all that physiology which relates to the phenomena of life, is wholly removed from the logic of quantity, and depends entirely on observation. Now so far as the logic of quantity is applicable, so far are we certain of our conclusions, as certain at least as we are of our own existence, or that we see and hear. But when this logic cannot be applied, our conclusions are no longer such as *must* be—no longer follow from our premises a necessary consequence; but are only, for the most part, such as *may* be; that is to say, have no more than that degree of probability which arises from the evidence we have of the truth of the phenomena or events, forming our premises.

In all knowledge depending on mere observation or experiment, what we know, is grounded on our own observation and experience, or on the observation and experience of others. What we ourselves observe, we too often observe very imperfectly; or do not understand, when observed. But phenomena or events, the knowledge of which we are obliged to receive at second hand, on the *testimony* of others; and which may have been observed through the distorted medium of ignorance or of prejudice—may even have been wilfully misrepresented—of these we have a still less assurance. If a phenomenon or event has happened only once, and be therefore historical; we are under the necessity of acquiescing in its truth, or of estimating its probability, according to the rules of evidence. If the phenomenon or event be of frequent occurrence, or if its nature be such, that it is capable of being brought under our own observation; in order to remove our uncertainty, we endeavour to observe it ourselves; in short, we make an experiment. Such is the method we pursue, in obtaining all that knowledge which is the result of mere observation. The different events succeed one another, but we know not wherefore; we see not their

mutual connexion. We believe that an event will, *probably*, follow another event; because the one event has always followed the other, or because of some other probability; but we cannot discover that *necessary* connexion between the two events, which so irresistibly leads us to determinate conclusions, where we can apply the laws of quantity.

The foregoing remarks may be viewed as a continuation of those offered in the introduction to this volume, and chiefly relate to the progress of chemistry. Chemistry being a science of observation, we can form but a very imperfect conception of its future progress; because, we cannot, by reasoning, anticipate the discovery of those chemical facts which are yet concealed. The progress that chemistry, within these few years, has made, is truly astonishing; and when a more rigorous mode of observation shall be adopted—in short, when chemistry shall be brought more under the control of the laws of quantity—a control that will be exercised at least indirectly—it is impossible to foretell the degree of perfection which chemistry, as a science, may attain. But, for many years yet to come, the progress of chemistry must depend solely on experiment; and its cultivators must be satisfied with the comparatively humble office, of discovering the actual chemical changes, which bodies effect on each other.

Since, then, in knowledge derived from observation, an acquaintance with *what exists*, and with *what is done*, is indispensable; to obtain a clear, accurate, and unequivocal conception of these things, is the first duty of every observer, and of every experimentalist. Nor is there any observer, or experimentalist, however unpretending, who may not add to the stock of ascertained facts; so varied and inexhaustible are the stores of nature. Another duty of every one who engages in observation or experiment, is to become the faithful historian of what he witnesses; to narrate the event or phenomenon in plain and intelligible language, employing only terms of a definite meaning; so as to convey to others a just notion of what he has seen. We say a *just* notion: in the greater number of instances, a *perfect* notion is impossible; because what is seen, cannot be expressed by language. But to give a just notion; that is to say, a notion which, though incomplete, *has no foreign or false gloss*, is within the power of every observer; and to give such a notion of the facts he narrates, ought to be his chief study. One testimony of so faithful a witness is often invaluable, and worth a thousand vague and inaccurate observations; which are only calculated to bewilder, or to mislead; and thus are worse than useless.

The next rule which an interpreter of nature should bear in mind, is *not to attempt too much at first*; but in order to establish a sure foundation for his succeeding labours, he ought to be content with obvious and unexceptionable facts; and so to arrange these facts, as to lead to others. To elicit novel and prominent facts, is the lot of

few; and any one may happen to be so successful. But all, as before stated, may *investigate truth*; and thus contribute more or less towards the advancement of knowledge. Moreover the humblest contributors may rest assured, that they are imperceptibly raising a structure, which will sooner or later include the conspicuous labours of their more fortunate coadjutors; in which structure, these labours will indeed still appear conspicuous; though their importance will be diminished as the fabric is extended around them.

The remarks just made, have especial reference to the application of chemistry to physiology. The cautious and judicious application of chemistry to physiology has already effected much, and is capable of effecting still more. Indeed it is hardly possible to say, how far chemistry may extend physiological knowledge. But chemistry, in its present state, in order to be made really useful, must be applied in a manner the most guarded and sparing—must, indeed, be rigidly confined to the ascertainment of *what the living principle does*; and *how it operates on inorganic principles*. With the living, the animative properties of organized bodies, chemistry has not the smallest alliance; and probably will never, in any degree, elucidate these properties. The phenomena of life, are not, even remotely, analogous to anything we know in chemistry, as exhibited among inorganic agents. The great error of chemists, therefore, has been their attempting to apply that science to explain phenomena, for the explanation of which, chemistry, as we have said, is totally valueless. Such perversion of the reasoning powers, has too much prevailed among physiologists in all ages. In the earlier ages, heat was considered the principle of life. In later times, electricity has been discovered; and to electricity, the same functions have been ascribed. Life, according to other philosophers, is motion. But the progress of science has dispelled all these illusions: the origin of the obscure and evanescent principle of life, must be sought elsewhere. By heat, for example, many wonderful things may be accomplished; but heat will not act itself. The powers of electricity are still more wonderful than those of heat: but electricity, we know to be governed, in its mode of action, by certain laws, and that it gives no sign of intelligence. In the same manner, life, as we are acquainted with it, cannot exist without motion; but motion can exist without life. Life and motion, consequently, are not synonymous terms; nor can we conceive the existence of motion, without a mover. In short, the living principle, as already pointed out, is something different from, and superadded to the common agencies of matter; over which, to a certain extent, it has a control. Thus, the phenomena exhibited by the mysterious agency of life, are strictly comparable only with one another; and have no relation to any inorganic phenomena.

But the desire of the Physiologist to ascribe to the agencies of inorganic matter, those operations carried on within living bodies, is

merely a display of that innate propensity of the human mind, which leads us to seek after First Causes. The conceptions of the physiologist regarding the principle of life are the same, therefore, as the conceptions of mankind in all ages regarding the Great First Cause—the Deity himself. The poor untutored savage “sees God in every cloud, and hears him in the wind.” The complacent philosopher smiles at the credulity of the savage, and perhaps defies “the laws of nature!” Both are alike ignorant; nor is the imagined Supreme Being of the untaught savage, in any degree, more absurd, than the imagined Pantheism of the philosopher. The winds we know can be referred to other causes, to which they are immediately owing: so with the progress of knowledge, the “laws of nature,” have been found to merge, and will continue to be found to merge, into other laws, still more general; thus proving that these laws are, all alike, mere delegated agencies. Hence the tendency of knowledge, and of its due application, is to abstract the attention from inferior things, and to fix the mind on the source of all knowledge and of all power—the GREAT FIRST CAUSE; who exists and acts throughout the universe; whom we can approach only, by studying His work; and whose works, an eternity will be inadequate to explore.

APPENDIX,

CONTAINING

ADDITIONAL NOTES AND EMENDATIONS.

Page 20.—"Forces of Gravitation."—Many objections have been offered to the term *vis inertiae* adopted by Newton. Indeed, to speak of mere *inertia*, or *inactivity*, as a force, is obviously absurd. We have always agreed with those who think that the term *inertia* has been unfortunately chosen; since *inertia* expresses only one quality, as it were, of that which is *attracted*, or which *reacts*, in nature. But, we fully acquiesce in the opinion, that whatever *resists attraction* or *reacts*, is as appropriately named a force, in a certain sense of that term, as that which *attracts* or *acts*; and such resistance is in all instances, virtually considered as a force by the mathematician, however he may choose to designate it.

Page 28.—We fear the terms *chemical* and *cohesive axes* are not quite legitimate. We have employed these and other familiar modes of expression, such as "*forces of gravitation*," "*polarizing forces*," &c. above alluded to, either on account of the general reader, for whom this work is principally intended, or for the sake of analogy.

Page 36.—Elementary form of electrical energies, &c. Throughout this work, as just observed, we have adhered as much as possible to the common language of chemistry. We conceive, however, that chemical, and the allied, phenomena admit of being expressed in terms of hypotheses, of which the chief are the following:—

1. That every portion of matter attracts, and is attracted by, every other portion of matter, according to laws which have obtained universal assent.

2. That all matter, as it is known to us, exists in the condition of molecules; which molecules we consider to be virtually spheres or spheroids.

3. That all the spherical or spheroidal molecules, when unimpeded, revolve on their axes, with velocities, which in molecules having the same weight, are under similar circumstances, fixed and definite; but which velocities, in molecules of different weights, increase, according to a law which need not be here specified, as the weights of the molecules diminish.

4. That the molecules of the imponderable matters, light and heat,

are vastly less than those of any ponderable substance; hence, that the velocities of the molecules composing these imponderable matters, are inconceivably rapid; further, that the substance of these molecules is either fluid or elastic, so that they become more or less oblate, in proportion to the intensity of their motion.

5. That the imponderable molecules of light and heat obey the same laws by which ponderable matters are governed; but that these imponderable molecules are capable of pervading and operating within ponderable molecules, whose motions they influence by the intensity of their own motion; and that the molecules of imponderable matters thus appear in the character of agents.

Page 49, note.—The term “homogeneous” light is a misprint: we mean the unaltered light of the sun. Light and heat, and indeed all self-repulsive fluids may be supposed to possess two kinds of self-repulsive power: that which is common to them as fluids; and that which depends upon the action of individual molecules of such fluids when in certain positions, and which positions, these molecules are naturally inclined to assume under certain circumstances, particularly when in motion. Hence the marshalling of the individual molecules of light, supposed in this note, probably do not exist, at least so as to become apparent, till the light approaches, or passes through some ponderable medium. These phenomena of light, may perhaps, be rendered more intelligible, by what appears to happen with respect to gaseous bodies. The rapidity of the motion of gaseous bodies, through any permeable medium, increases as their specific gravity diminishes. Thus the force with which, the lightest of these bodies, hydrogen, struggles to escape through any porous matter, is almost incredible; according to Mr. Graham’s experiments, sufficient to raise a column of water from 20 to 30 inches. This rapidity of motion seems only explicable on the supposition, that the individual molecules of the gas, in their passage through narrow canals, are guarded from external and lateral influence; and are thus enabled to assume that position which is natural to them, and in which their mutual self-repulsion is the greatest possible. Hence, a single row of self-repulsive molecules of gas (or other self-repulsive fluid) passing through the minute apertures of a porous vessel into a vacuum, or what is analogous, into another gas having different self-repulsive powers, may be compared to a row of bullets urged by an elastic fluid, in quick succession through a gun barrel: but with this difference, that the gaseous molecules propel each other; instead of being, like the bullets, propelled by a foreign agency. The explanation now offered of the passage of the molecules of gas through a narrow canal, or through any porous matter, may, as we have said, be applied, not only to the passage of light and heat through various media; but also to the passage of liquids through various bodies, by the processes which have been termed *endosmose* and *exosmose*. Do these forces operate also in capillary attraction?

Page 112—TABLE OF TEMPERATURES.—(FROM

Isothermal zones.	Names of places.	Position.			Mean temperature of the year.
		Latitude north.	Longitude.	Height in feet.	
Isothermal zones from 32° to 41°.	Nain	57° 8'	61° 20' W	0	26.42°
	*Enontekies	68 30	20 47 E	1356	26.96
	Hospice de St. Gothard }	46 30	8 23 E	6390	30.38
	North Cape	71 0	25 50 E	0	32.00
	*Uleo	65 3	25 26 E	0	35.08
	*Umeo	63 50	20 16 E	0	33.26
	*St. Petersburg	59 56	30 19 E	0	38.84
	Drontheim	63 24	10 22 E	0	39.92
	Moscow	55 45	37 32 E	970	40.10
	Abo	60 27	22 18 E	0	40.28
	Isothermal zones from 41° to 50°.	*Upsal	59 51	17 38 E	0	42.80
*Stockholm		59 20	18 3 E	0	42.26
Quebec		46 47	71 10 W	0	41.74
Christiana		59 55	10 48 E	0	42.08
*Convent of Pey- } senburg }		47 47	10 34 E	3066	42.98
*Copenhagen		55 41	12 35 E	0	45.68
*Kendal		54 17	2 46 W	0	46.22
Malouine Islands		51 25	59 59 W	0	46.94
*Prague		50 5	14 24 E	0	49.46
Gottingen		51 32	9 53 E	456	46.94
*Zurich		47 22	8 32 E	1350	47.84
*Edinburgh		55 57	3 10 W	0	47.84
Warsaw		52 14	21 2 E	0	48.56
*Coire		46 50	9 30 E	1876	48.92
Dublin		53 21	6 19 W	0	49.10
Berne		46 5	7 26 E	1650	49.28
*Geneva		46 12	6 8 E	1080	49.28
*Manheim	49 29	8 28 E	432	50.18	
Vienna	48 12	16 22 E	420	50.54	

* At the places thus distinguished, the temperatures

ENCYCLOPEDIA METROPOLITANA.—ARTICLE METEOROLOGY.)

Distribution of heat in the different seasons.				Maximum and minimum.	
Mean temperature of winter.	Mean temperature of spring.	Mean temperature of summer.	Mean temperature of autumn.	Mean temp. of warmest month.	Mean temp. of coldest month.
-0.60°	23.90°	48.38°	33.44°	51.80°	-11.28°
+0.68	24.98	54.86	27.32	59.54	-0.58
18.32	26.42	44.96	31.82	46.22	+15.08
23.72	29.66	43.34	32.08	46.58	22.10
11.84	27.14	57.74	35.96	61.52	7.70
12.92	33.80	54.86	33.44	62.60	11.48
17.06	38.12	62.06	38.66	65.66	8.60
23.72	35.24	61.24	40.10	64.94	19.58
10.78	44.06	67.10	38.30	70.52	6.08
20.84	38.30	61.88	40.64	—	—
24.98	39.38	60.26	42.80	62.42	22.46
25.52	38.30	61.88	43.16	64.04	22.82
14.18	38.84	68.00	46.04	73.40	13.81
28.78	39.02	62.60	41.18	56.74	28.41
28.58	42.08	58.46	42.98	59.36	30.20
30.74	41.18	62.60	48.38	65.66	27.14
30.86	45.14	56.84	46.22	58.10	34.88
39.56	46.58	53.06	48.46	55.76	37.40
31.46	47.66	68.90	50.18	—	—
30.38	44.24	64.76	48.74	66.38	29.66
29.66	48.20	64.04	48.92	65.66	26.78
38.66	46.40	58.28	48.56	59.36	38.30
28.76	47.48	69.08	49.46	70.34	27.14
32.36	50.00	63.32	50.36	64.58	29.48
39.20	47.30	59.54	50.00	61.16	35.42
32.00	48.92	66.56	49.82	67.28	30.56
34.70	47.66	64.94	50.00	66.56	34.16
38.80	49.64	67.10	49.82	68.72	33.44
32.72	51.26	69.26	50.54	70.52	26.60

given are the result of at least 8000 observations.

TABLE OF TEMPERATURES.

Isothermal zones.	Names of places.	Position.			Mean temperature of the year.
		Latitude.	Longitude.	Height in feet.	
Isothermal zones from 50° to 59°.	*Clermont	45° 46'	3° 5' E	1260	50.00°
	*Buda	47 29	19 1 E	494	51.08
	Cambridge, (U. S.)	42 25	71 3 W	0	50.36
	*Paris	48 50	2 20 E	222	51.08
	*London	51 30	0 5 W	0	50.36
	Dunkirk	51 2	2 22 E	0	50.54
	Amsterdam	52 22	4 50 E	0	51.62
	Brussels	50 50	4 22 E	0	51.80
	*Franeker	52 36	6 22 E	0	51.80
	Philadelphia	39 56	75 16 W	0	53.42
	New York	40 40	73 58 W	0	53.78
	*Cincinnati	39 6	82 40 W	510	53.78
	St. Malo	48 39	2 1 W	0	54.14
	Nantes	47 13	1 32 W	0	54.68
	Pekin	39 54	116 27 E	0	54.86
	*Milan	45 28	9 11 E	390	55.76
Bordeaux	44 50	0 34 W	0	56.48	
Isothermal zones from 59° to 68°.	Marseilles	43 17	5 22 E	0	59.00
	Montpellier	43 36	3 52 E	0	59.36
	*Rome	41 53	12 27 E	0	60.44
	Toulon	43 7	5 50 E	0	62.06
	Nangasacki	32 45	129 55 E	0	60.80
	*Natchez	31 28	90 30 W	180	64.76
Isothermal zones from 68° to 77°.	*Funchal	32 37	16 56 W	0	68.54
	Algiers	36 48	3 1 E	0	69.98
Isothermal zones above 77°.	*Cairo	30 2	31 18 E	0	72.32
	*Vera Cruz	19 11	96 1 W	0	77.72
	*Havannah	23 10	82 13 W	0	78.08
	*Cumana	10 27	65 15 W	0	81.86

* At the places thus distinguished, the temperatures

(CONTINUED.)

Distribution of heat in the different seasons.				Maximum and minimum.	
Mean temperature of winter.	Mean temperature of spring.	Mean temperature of summer.	Mean temperature of autumn.	Mean temp. of warmest month.	Mean temp. of coldest month.
34.52°	50.54°	64.40°	51.26°	66.20°	28.04°
33.98	51.08	70.52	52.34	71.60	27.78
33.98	47.66	70.70	49.82	72.86	29.84
38.66	49.28	64.58	51.44	65.30	36.14
39.56	48.56	63.14	50.18	64.40	37.76
38.48	48.56	64.04	50.90	64.76	37.75
36.86	51.62	65.84	51.62	66.92	35.42
36.68	53.24	66.20	51.08	67.28	35.60
36.68	51.08	67.28	54.32	69.08	32.90
32.18	51.44	73.94	56.48	77.00	32.72
29.84	51.26	79.16	54.50	80.78	25.34
32.90	54.14	72.86	54.86	74.30	30.20
42.26	52.16	66.02	55.76	66.92	41.74
40.46	54.50	68.54	55.58	70.52	39.02
26.42	56.30	82.58	54.32	84.38	24.62
36.32	56.12	73.04	56.84	74.66	36.14
42.08	56.48	70.88	56.30	73.04	41.00
45.50	57.56	72.50	60.08	74.66	44.42
44.06	56.66	75.74	60.98	78.08	42.08
45.86	67.74	75.20	62.78	77.00	42.26
48.38	60.80	75.02	64.40	77.00	46.40
39.38	57.56	82.94	64.22	86.90	37.40
48.56	65.48	79.16	66.02	79.70	46.94
64.40	65.84	72.50	72.32	75.56	64.04
61.52	65.66	80.24	72.50	82.76	60.08
58.46	73.58	85.10	71.42	85.82	56.12
71.96	77.90	81.50	78.62	81.86	71.06
71.24	78.98	83.30	78.98	83.84	69.98
80.24	83.66	82.04	80.24	84.38	79.16

given are the result of at least 8000 observations.

Page 142, note.—We have stated that the diffusion of the same air, and of the same vapour at different temperatures, are inferences only from the supposed general law of the diffusion of gaseous bodies; and have alluded to the existence of modifications of that general law. To those who feel an interest in such inquiries, the following additional remarks may be not unacceptable, as pointing out the grounds from which we infer such diffusion of the same air and vapour; and the modifications, to which we have no doubt, it will be found to be liable.

Let us suppose a flexible air-tight bag to be furnished with a stop-cock; and to be filled with hydrogen gas, under exactly the same pressure, and having the same temperature as the surrounding atmosphere. Let us now suppose the stop-cock to be opened. Immediately, the hydrogen in the bag, and the exterior atmospheric air, will begin to commingle, with a force and velocity proportional to the quantity of the gas diffused; and which quantity varies inversely as the square roots of the specific gravities of hydrogen gas, and of atmospheric air; that is to say, the volume of atmospheric air diffused inwards, being supposed to be equal to 1, the volume of hydrogen diffused outwards, will be equal to 3.8 nearly. The diffusion of hydrogen and atmospheric air of the same temperature, and under the same pressure, is an instance of the simplest form of gaseous diffusion; and is, we believe, the only form of diffusion, which has been experimentally investigated. The phenomena attending the diffusion of these two bodies show, that, all other circumstances being supposed to be alike, the diffusion of gases is influenced solely by the difference of their specific gravities.

We have stated the case of the diffusion of two gaseous bodies having the *same* temperature. Their temperature however, may vary within any limits; and though the law of diffusion may be modified, diffusion will continue to take place, (except at those temperatures at which the specific gravities of the two gases become equal, at which temperatures there will be no tendency to diffusion); provided difference of specific gravity alone be the cause of diffusion. But if the diffusion of different gases at different temperatures be admitted, it seems to follow, that different portions of the *same* gaseous body under the same pressure, but having different temperatures, and consequently different specific gravities, will likewise have a tendency to diffusion.

The case we shall next suppose is dissimilar to the two foregoing cases, but is deducible from the same premises: it is the case of the diffusion of the same vapour, as of the vapour of water, which may be illustrated in the following manner:

Let us suppose our apparatus to contain atmospheric air, having the temperature of 100° , and saturated with water; while the exterior atmospheric air is at the temperature of 60° , and is likewise saturated with water; and that the pressure on the air confined in the bag, is the same as the external pressure. We suppose the pre-

sence of air in the apparatus, in order that it may be able to sustain the atmospheric pressure; for, as we formerly stated, vapour alone, at ordinary temperatures, exerts elastic forces very different from, and far inferior to the elastic force of air at these temperatures. Such being supposed to be the state of the air contained in our apparatus, what will happen on the opening of the stop-cock? The air within the bag will have the same tendency to diffusion, as the contents of the bag supposed in the last case; but the vapour with which the air is associated will have an opposite tendency. The warmer vapour within the apparatus, instead of being, like the warmer air, lighter; will have a greater specific gravity than the colder vapour associated with the external air. Consequently, the inward tendency to diffusion, that is to say, the tendency of the colder vapour without the apparatus, to diffuse itself among the molecules of the warmer vapour within will be greater than the outward diffusive tendency of the vapour in the apparatus. Such will be the opposing diffusive tendencies of warm vapour and of warm air in a state of commixture; and if the air were absent, the diffusive tendency of vapour alone would have a similar diffusive tendency to that which it has, when mixed with air; though that tendency would, of course, be not exactly the same as when modified by the influence of the air. The vapour within, and the vapour without the apparatus, would each exert the elastic forces peculiar to their respective temperatures as vapour.

There would, however, be a striking difference between the phenomena attending the diffusion of vapour, (whether mixed or unmixed with air), and that of air itself at different temperatures. Two portions of air at different temperatures would cease to have any diffusive tendencies as soon as their temperatures became uniform. The temperature of two portions of vapour becoming uniform, would, of course, produce, in the same manner, a cessation of their diffusive tendencies; but the circumstances accompanying that cessation would be altogether different. The colder vapour without the apparatus, being the lighter, would move with accelerated velocity into, or toward, the heavier warm vapour within the apparatus; while that warm vapour, in moving outward, would be instantly condensed; and thus its diffusive powers would be annihilated. On these grounds we advanced the opinion, that *probably*, there may, under certain circumstances, exist in the atmosphere, a tendency to diffusion from above downwards; the vapour in the higher regions of the atmosphere, being relatively lighter than the vapour below.

The observations that have been offered in this note, regard the only circumstance which is yet known to cause a difference in this diffusive tendency of gaseous bodies, namely, the difference of their specific gravities. If there be other causes of such difference; and it is almost certain that there is *one* other cause; the effects pro-

duced by these causes may be very different. The difference in the diffusive power of the same gaseous body, is not perhaps, under any circumstances, very remarkable; but there will probably be found to be a much greater difference in the diffusive power of vapours; though it is not easy to form even a conjecture as to the extent of that difference. In the present state of uncertainty therefore on those points, we have thought it right to speak of a *tendency* to diffusion, rather than of diffusion, as a thing actually existing. The diffusive powers of elastic fluids are at present very little understood or appreciated. They constitute, however, as we have said, one of the most interesting and important subjects in physics, and would amply repay whoever would take the trouble to investigate them.

Page 184.—The table follows, illustrating the distribution of plants over the globe, to which we have referred in the text. It has been copied immediately from Lindley's Introduction to Botany.



Groups	Proportion to the whole mass of Phanogamous plants.		
	Equatorial Zone, Lat. 0°—10°.	Temperate Zone, Lat. 45°—52°	Frozen Zone, Lat. 67°—70°.
Agamæ (<i>Ferns, Lichens, Mosses, Fungi</i>)	{ Plains $\frac{1}{15}$ }	. . . . . $\frac{1}{2}$	. . . . . $\frac{1}{1}$
	{ Mountains $\frac{1}{9}$ }	. . . . . $\frac{1}{70}$	. . . . . $\frac{2}{5}$
	{ Countries nearly flat $\frac{20}{5}$ }	. . . . . $\frac{1}{8}$	. . . . . $\frac{1}{4}$
	{ Countries very mountainous $\frac{1}{5}$ to $\frac{1}{8}$ }	. . . . . $\frac{1}{2}$	. . . . . $\frac{1}{25}$
Ferns alone	{ Old Continent $\frac{1}{5}$ }	. . . . . $\frac{1}{4}$	. . . . . $\frac{1}{3}$
	{ New Continent $\frac{1}{6}$ }	. . . . . $\frac{1}{8}$	. . . . . $\frac{1}{4}$
Monocotyledones . . . . .	. . . . . $\frac{1}{11}$	. . . . . $\frac{1}{8}$	. . . . . $\frac{1}{4}$
Glumacæ (<i>Junceæ, Cyperacæ, Graminæ</i>)	. . . . . $\frac{4}{100}$	. . . . . $\frac{9}{90}$	. . . . . $\frac{1}{25}$
Junceæ alone	{ Old Continent $\frac{2}{2}$ }	. . . . . $\frac{1}{20}$	. . . . . $\frac{1}{5}$
	{ New Continent $\frac{1}{5}$ }	. . . . . $\frac{1}{8}$	. . . . . $\frac{1}{10}$
Cyperacæ alone . . . . .	. . . . . $\frac{1}{14}$	. . . . . $\frac{1}{12}$	. . . . . $\frac{1}{10}$
Graminæ alone	{ Old Continent $\frac{1}{18}$ }	. . . . . $\frac{1}{8}$	. . . . . $\frac{1}{13}$
	{ New Continent $\frac{1}{2}$ }	. . . . . $\frac{1}{6}$	. . . . . $\frac{1}{5}$
Compositæ	{ Old Continent $\frac{1}{10}$ }	. . . . . $\frac{1}{6}$	. . . . . $\frac{1}{80}$
	{ New Continent $\frac{1}{4}$ }	. . . . . $\frac{1}{60}$	. . . . . $\frac{1}{80}$
Leguminosæ	{ Old Continent $\frac{1}{10}$ }	. . . . . $\frac{1}{80}$	. . . . . $\frac{1}{500}$
	{ New Continent $\frac{1}{25}$ }	. . . . . $\frac{1}{40}$	. . . . . $\frac{1}{70}$
Rubiaceæ . . . . .	. . . . . $\frac{1}{32}$	. . . . . $\frac{1}{80}$	. . . . . $\frac{1}{70}$
Euphorbiacæ . . . . .	. . . . . $\frac{1}{40}$	. . . . . $\frac{1}{80}$	. . . . . $\frac{1}{70}$
Labiata . . . . .	. . . . . $\frac{1}{55}$	. . . . . $\frac{1}{80}$	. . . . . $\frac{1}{70}$
Malvacæ . . . . .	. . . . . $\frac{1}{130}$	. . . . . $\frac{1}{80}$	. . . . . $\frac{1}{70}$
Ericæ $\frac{1}{800}$ $\frac{1}{80}$ $\frac{1}{70}$
Amenacæ $\frac{1}{800}$ $\frac{1}{80}$ $\frac{1}{70}$
Umbellifera $\frac{1}{800}$ $\frac{1}{80}$ $\frac{1}{70}$
Crucifera $\frac{1}{800}$ $\frac{1}{80}$ $\frac{1}{70}$





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